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REPORT

OF THE

State Sewerage Commission

OF

New Jersey

1905

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REPORT

OF THE

New Jersey

State Sewerage Commission

[7th] 1905

TO THE

Legislature of 1906

TRENTON, N. J.
MacCrellish & Quigley, State Printers
1906

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REPORT.

To the Legislature:

The State Sewerage Commission herewith presents its annual report, showing the operations under the act of 1899 and the supplements thereto, during the year 1905. The report of the Secretary gives the details of the Commission's meetings and acts, together with other information regarding the general subject of sewerage and its supervision in the State. The report of the Commission's Treasurer shows the expenditures under the appropriations, all of which were approved by the Governor, after having been passed upon by the Commission. Reports of the sewerage conditions in the various municipalities of the State are given, presenting statistics of much value. Detailed reports are also presented by engineers employed upon various branches of the Commission's work, and by the chemist and bacteriologist. The paper presented by George W. Fuller, engineer, upon the relations of sewage pollution to shell-fish, contains the data upon the subject up to the present. The Commission is confident that the several reports and the numerous facts presented will be found of much value to all interested in this most important branch of public work.

The Commission has found its duties increasing with each year and its field constantly widening, and it is probable that this expansion will continue hereafter, as the growth of municipalities continues and the requirements of proper sewerage are better understood. The population of the State is bound to grow more congested, and as rural communities develop into suburban towns, the demands for sanitary improvements increase even more rapidly. Conditions which caused hardly a murmur of disapproval a generation ago are now regarded as intolerable, and the growth of refinement in the household is reflected in the

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government. The introduction of a water-supply requires means to carry away the water after it has been used, and every additional facility for comfort and cleanliness adds to the problem which confronts the sanitary engineer. The increase in the population of the State is largely made up of those who have lived in great cities, and they demand conveniences to which they have been accustomed. Every small town, when undergoing the changes from rural to suburban life, finds itself burdened by the necessity of great works to accommodate the new requirements, and it is inevitable that large debts shall be incurred to meet the demands of the changed conditions. To guide this expenditure, to impress upon the communities the necessity of planning broadly for the future, and to regulate the relations of each with the other, is a task which properly belongs to a State body. The supervision of sewerage is one of the most necessary of these State duties. Not only are the interests of the community constructing works vitally concerned, but there is not one city or town in the State which does not discharge its sewage in a way to affect some other community to some degree. As surely as water must flow down hill, the sewage must find its way to the sea, and it has become evident that even the communities upon the ocean's edge cannot be reckless in the discharge of the fluid wastes without endangering the welfare of others. Political boundaries seldom follow the physical conformation, while sewerage must do so, and complications are certain to arise between communities as a result. Each is necessarily and properly selfish in conserving its own interests, and appeals to State authority are the only means of adjusting the conflicts. This authority cannot be exercised by any rigid rule, and only the most general principles can be adopted to guide action. It is necessary to leave the local bodies as much latitude as possible, yet to be firm in checking error; to concede to one temporary privileges which cannot be granted to all, and to adapt requirements to local conditions, capacity and means. Attempts at iron regulation would either discourage sanitary improvement, or fail in securing obedience. The supervising authority should therefore possess ample power, yet use it cautiously, and no better method of exercising the functions

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which sewerage conditions demand has been devised than that which gives a State Commission control. That the subject is not one which could be made a mere branch of other general work has been shown conclusively by this Commission's experience.

During the last year the Sewerage Commission has been able to give much more thorough consideration of the matters before it by means of the increased appropriation allotted it, permitting the employment of experts to ascertain exact chemical and bacterial conditions; to suggest engineering devices, and to advise communities seeking relief. Full reports of these operations are included herewith, and the facts presented are of general importance.

THE PASSAIC RIVER.

The State Commission regrets to report that no further progress has been made toward the purification of the Passaic river. It is now nearly ten years since the then Governor, the Hon. John W. Griggs, of Paterson, directed attention to the foulness of the river from the discharge of sewage into the stream. Upon his recommendation, a Commission of three citizens was authorized by the Legislature and appointed by him, consisting of Elias J. Marsh, of Paterson, and Dr. H. C. H. Herold and William T. Hunt, of Newark. An elaborate investigation was made, aided by competent engineers, under the direction of Alphonse Freley, of New York, and Charles E. Jacobson, of Newark. In a report made to the Legislature of 1897, the Commission reported that the condition of the river was so foul from sewage that early remedies were required, for the benefit of property and for the public health. The method proposed was the construction of a trunk sewer from the Falls of the Passaic at Paterson to Newark bay, to collect the sewage from both sides of the river, discharging it into the channel of the Bay, where the flow of the Passaic and Hackensack rivers join. A State commission of three members was suggested, to perform the work, with power to assess the cost upon the several municipalities benefited by the improvement, according to such benefits. The cost of the work was estimated at $6,500,-

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000, and the annual maintenance charge at $125,000 in 1900 and $300,000 in 1930. The discharge of the sewage into Newark bay was reported by the Commission to be unobjectionable at that time, owing to the large dilution it would receive, but the plan included a recommendation that provision be made for subsequent purification at the outlet, should it be found necessary. The report was approved by Governor Griggs in a special message forwarding it to the Legislature.

No legislative action was taken at that time, except to refer the report of the Commission to a legislative committee. That committee held several public hearings, and reported that there was considerable opposition to the plan, mainly from the city of Bayonne upon Newark bay, where it was felt that the crude sewage discharge might affect the comfort and health of residents. Objection to the high cost was also made by the officials of several of the cities and towns.

The Legislature of 1898, still disinclined to action, referred the whole subject to a new commission, the members of which were William T. Hunt, James A. Exton, M.D., Herman C. H. Herold, M.D., Charles F. Harrington, Elias J. Marsh, Jr., Charles W. Fuller and William Kent.

No funds were available for the employment of engineering advice by this commission, but numerous sessions were held, and a report was made by a majority of the commission in favor of the trunk sewer plan, while a minority objected. This report was discussed at length in the Legislature of 1899, and an act was finally passed creating the State Sewerage Commis,-sion, with William T. Hunt of Essex county, John Hinchliffe of Passaic, Charles W. Fuller of Hudson, Charles F. Harrington of Bergen, and David L. Wallace of Essex, as members. No power to remedy the evil conditions of the Passaic river was conferred upon this Commission, beyond the regulation of further sewerage construction; but in the following year, 1900, at the recommendation of the commission, authority was at last given. In June of 1900 the Commission issued an order to the municipalities on the river to cease the discharge of sewage into the Passaic before June, 1904. The limit of four years was fixed after consultation with the authorities of all the cities and

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towns, and with their substantial agreement. No objection was made to the time limit. The law of 1899 had permitted the communities to establish a sewerage district, to include the places offending, with local commissioners, and this act was extended and modified in several details, which will be found set forth in the reports of this Commission.

It was anticipated that measures for either joint action for a trunk sewer or for separate disposal plans would be taken, but time elapsed without event, and the legislative session of 1901 passed without measures for investigation being taken, although it was agreed the report of 1897 should receive further consideration.

Governor Voorhees, after the adjournment of the Legislature of 1901, communicated with the State Commission, and as a result of the conferences, he agreed to allow the Commission the sum of $8,000 from the emergency fund under his control, and directed a full investigation of the subject to be made. The Commission proceeded at once with a thorough examination of the matter. Messrs. Colin R. Wise and Robert M. Watson of Passaic, William Ferguson of Paterson, and James Owen of Montclair, well-known engineers, were employed for detailed work, and, as advisory engineers, three of national repute were selected, Messrs. Rudolph Hering and J. J. R. Croes of New York, and William M. Brown of Boston. The report of these engineers and of the Commission was embodied in the Commission's annual report to the Legislature at the session of 1902. While favoring the trunk sewer plan of relief, the advisory engineers suggested that the place of final discharge should be the bay of New York, near Robbins Reef Light, instead of Newark bay, preferring this to the plan of Engineer Owen for a purifying plant on the Newark meadows, with a discharge into Newark bay, as less costly. The total cost was estimated at $9,000,000.

The Legislature of 1902 received this report, and after extended discussion, directed the creation of a District Commission, to be appointed by the Governor, with power to proceed with the construction of a trunk sewer emptying into New York bay. By this act, the entire control of the drainage area of the

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Passaic river was placed in the hands of the Commission, and, unfortunately, it practically suspended the order of the State Commission for the removal of sewage from the river in 1904. The District Commission proceeded with its work immediately upon the appointment of the Commissioners, and again caused surveys to be made and a thorough revision of previous investigations was made. The District Commission expended about $25,000 in this work, and again reported in favor of the trunk sewer plan, with the outfall into New York bay.

Although the courts had had the general scheme of the trunk sewer before them and had given their assent to the methods, in apparently conclusive opinions, the District Commission act was questioned upon constitutional grounds relating to the assessment of the cost, the city of Paterson opposing the act, and the Court of Errors and Appeals, in the early part of this year (1905), declared so much of the act as related to taxation to be void. This deprived the District Commission of means to pay for any part of its work, and compelled it to suspend all action. It did not, however, invalidate other provisions of the law, and as a consequence, the whole question was left in suspense, the District Commission remaining in full control of the Passaic valley sewerage question, yet possessing no powers for remedying the bad conditions. The Legislature took no measures to solve this problem, and there the great work rests.

The condition of the Passaic river meanwhile has grown worse each year, as the volume of sewage has increased, and as the normal fresh-water flow of the river has decreased, by reason of the demands upon the upper river for water-supplies. The injury to property along the banks has been greater each year, checking the natural development of the whole section, and the effect upon health is more obvious now than at any previous time. The conditions, which were bad enough ten years ago to call for early remedy, have now become such as to make failure to provide such remedy a grievious wrong. The effect upon public respect for the machinery of government will be harmful if there continues to be effort without result.

The obstacles which now exist are apparently, first, the difficulty of finding a scheme of assessment which would satisfy

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the courts as to its nature and equitable effect; and second, the opposition which has been made by the authorities of the city of Paterson to the scheme of a trunk sewer. It appears to this Commission that the legal questions may be solved by consultation with all the State authorities, and it is suggested that the Attorney General be given special powers to consider this subject of assessments, and devise a constitutional plan for immediate adoption.

The city of Paterson is now defendant in suits for large amounts for damages to riparian owners caused by the city's sewage discharge into the river. In a recent answer, its counsel agrees, on behalf of the city, to provide remedies within a reasonable period, five years, and the Court of Chancery will, it is presumed, have power to enforce the performance of this agreement. The city now fully admits the necessity of remedial action, but still claims, as it has in the past, that it could provide a separate and independent system of sewage disposal at a lower cost than that of its connection with the trunk sewer. While its own engineering advice, sought independently from reputable authority, discourages this view, and while all other examinations have shown that Paterson would be a beneficiary of the trunk sewer plan, there is no disposition to oppress it, nor to stand in the way of any sure and prompt remedial plan. But this Commission feels that action must be taken at once, and that any alternative to the trunk sewer plan must be clearly satisfactory to State authority before it be approved. It is to be remembered that the State's policy of a general system of relief has been definitely determined, and that Paterson, by authority, once consented to relief measures for the removal of the nuisance by June, 1904, and that it is now under pledge to act. It cannot, therefore, claim to be unjustly treated if the action of the legislative session of 1906 be made final and peremptory.

The remaining cities and towns of the Passaic valley are prepared for action, and ready to bear their proper share of the cost of the great work. At a meeting called by the Newark Board of Trade on November 14th, 1905, at which his Excellency, the Governor, was present, the subject was fully discussed

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by representatives of the several localities interested and this Commission was also represented. The views there expressed left no doubt as to the fact that the community of the Passaic District is prepared for action, and, indeed, impatient at the delay. The State Commission recommends immediate action upon the Passaic valley sewerage. It recommends the repeal of the act creating a district commission, and the enactment of a new law providing for the selection of district commissioners by some form of popular representation, their work to be supervised, as in other cases, by the State Commission, so far as the general plans and inspection of the work be concerned.

It is very desirable, in the opinion of this Commission, that there should be State supervision of such a work. State interests are involved, the communities outside the district are concerned as to the discharge of the sewers, and the relations of the State to other States and to the Federal government are affected. State authority should, therefore, have a voice, and this Commission is the natural board for such control.

Before leaving this subject, there should be mention made of two matters bearing upon the problem. The first relates to the attitude of the Federal government in regard to the improvement. It should be understood that there has never been any real action by authority of the government in regard to the trunk sewer. In 1897 the proposed discharge of the trunk sewer into Newark bay was submitted to the War Department, and the then Secretary, Hon. Russell A. Alger, directed a report to be made to him from the army engineers in charge of this department. In that report the engineers objected to the discharge of crude sewage into Newark bay, on the ground that the solid deposits would interfere with navigation interests and affect the channel, which was being maintained by the government at considerable expense. This objection would make it necessary to provide some plan for removing the solids from the sewage before it should be discharged, a simple mechanical process which should be adopted under any circumstances.

To the discharge of the sewage into New York bay after removing the solids, no objection has been made by the Federal authorities. On the other hand, the engineers of the army in

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charge of the district have, upon inquiry, replied that they have found no objection to the discharge of the sewage from a sanitary point of view, as the waters of New York bay are equal to disposing of this additional amount of sewage without offence.

Certain objections raised by the State of New York to the point of discharge are in the opinion of those best qualified to judge, without legal foundation and without support from a sanitary standpoint.

INSPECTION OF SEWERAGE PLANTS.

Extended examinations of the sewerage plants in operation throughout the State have been made by the Commission and through its agents. In almost every case, these disclosed conditions requiring improvement in construction, or management, and in each case such suggestions as seemed advisable were made by the Commission, with resulting improvement where action has been obtained. The need of such supervision is obvious after even a casual inspection.

The Commission has not found a single institution in this State with sewage purification plant in proper condition. It finds it difficult to obtain action to remedy this condition. In some cases, there is disregard for sanitation, even in plumbing and the necessary conveniences for the care of inmates. It takes from one to five years for this Commission, with its present powers, to obtain action on its recommendations. These institutions are under the charge of State commissions or county boards of chosen freeholders.

In three counties, the county institutions have disposal plants: Essex, Burlington and Camden. In Essex, at the Overbrook Asylum, a plant was voluntarily installed before the creation of this Commission. It has done good work, but is inadequate for present needs. The Asylum is being greatly enlarged, and the Commission is informed that, when this work has progressed sufficiently, plans will be prepared for a disposal plant of sufficient size.

In Burlington county, plans were approved by this Commission for a disposal plant for the institutions at New Lisbon.

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The plant has been mismanaged through ignorance, but could do good work. It appears, however, on examination, that only part of one institution was connected with the plant. Recommendations for the correction of existing evils have been made to the County Freeholders, as appears in the report of the Secretary; and it is hoped that in time this plant will be in good working order.

In Camden county the Commission has for five years tried to get a proper disposal of sewage at the institutions at Asyla. Under its statutory power, it ordered pollution to cease and plans to be submitted. In course of time the matter was acted upon, but through mistake or ignorance of the law, the plans chosen were not submitted to this Commission for review. A plant was built which should have done the required work, but mechanical defects and lack of care have put it in bad shape. Full recommendations for improvement were made in this case, and a year has been spent in trying to get action. The contractors who installed the plant have now undertaken to repair it to meet the approval of this Commission, but action is slow and unsatisfactory.

In each case, the Board in charge seems to have good intentions, but to be too deliberate in action. In regard to the State institutions, these matters are very marked. This Commission has always considered that the State should set an example in this matter and tried to see that it did, but with limited or negative results. At the State Reformatory, by its directions, plans were adopted which this Commission published in a former report as a good example of a purification plant. The plant was partially constructed, and now lies abandoned. In this case, however, an appropriation was granted for a new plant, but through no fault of the Commission in charge, was lapsed on November 1st, 1905, as it could not be used. This Commission is informed that its allowance will be again applied for at the present session of the Legislature. This Commission recommends that such appropriation be made as may be necessary.

At Jamesburg, the sewage from the School for Boys is being partially purified in a very unsatisfactory manner. A system of purification was installed without the knowledge or consent of

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this Commission, against the statute. This Commission requested that the plans be submitted and received them, but it has been unable to approve them. Full advice and suggestions have been submitted to the Trustees, but as yet no action has resulted.

At the State Hospital for the Insane at Morris Plains, a system of sewage purification was established before the creation of this Commission. It has now been in use for about seventeen years, and was designed to care for about eight hundred people, but the population of the Hospital has grown until there are now over two thousand inmates and attendants. The sewage is received in a double tank, the solid matter being screened out and removed. From the receiving tanks, most of the sewage flows through the primary and secondary filter beds, and the balance is used for broad irrigation. The system is inadequate and this Commission is informed that plans for proper treatment are being considered, and that it is probable that the Board of Managers will apply for an appropriation for installing a new system of disposal. In this case, also, this Commission recommends that such appropriation as is necessary be made for this purpose.

CARE OF SEWERAGE PLANTS.

It is again necessary to call attention to the lax management of sewerage plants. With one or two notable exceptions, the disposal plants in this State are in charge of men who are entirely ignorant of the theories according to which they are designed and constructed. These men naturally drift into the easiest method of conduct so far as physical exertion is concerned, and that method too frequently destroys the efficiency of the plant. Under such circumstances, the expense of construction may be charged to the profit and loss account. The Commission cannot too strongly urge the necessity of employing men who will study and take pride in their work.

The Commission also questions once more the wisdom of granting sewerage franchises to private companies. It is tempting to municipal authorities to keep a low tax rate by having this charge paid by a private company, but the users pay more as rental than the increase in tax burden would amount to, and those who escape by not connecting with the sewers are usually

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those who should be forced to connect by the local health board. The danger lies in the economy of the company. Such is the case at Collingswood, where a private company, after being compelled to put in a good plant, has allowed it to deteriorate until it is useless. Only by threats of injunction has the Commission been able now to secure a tardy and unwilling attempt at improvement.

It is only fair to state that all private companies are not so censurable. At Burlington, promptness in complying with suggestions for betterment is noted, and the plant is doing satisfactory work. In some small places, sewers are only to be had by voluntary association of residents, and in these cases incorporation is natural for mutual convenience.

SUMMER RESORTS.

It is poor policy which prevents the authorities of some of the seaside summer resorts from purifying the sewage of their municipalities. In winter the question is of small moment, as the permanent population is usually small and the sewage is diluted and washed away without nuisance. In the summer, however, the population of our coast towns is greatly multiplied. Decomposition of sewage is rapid, and the amount greatly increased, causing offensive nuisance. The value of the bathing beaches is endangered from sewage sludge being deposited along them. Yet the authorities hesitate to incur the comparatively small expense necessary to secure relief. Publicity has been given this matter in the newspapers, and some of our seaside resorts have undoubtedly suffered heavily in patronage as a punishment for their disregard of sanitation. Where action has been taken in some instances, it has been a makeshift.

The resorts in Monmouth county, especially Asbury Park and Ocean Grove, have caused criticism. Asbury Park started to reform, but, after having plans approved, decided not to proceed, and compromised with an extended sewer outlet. Atlantic City had plans approved several years ago, but has abandoned them and is preparing new plans based on engineering investigations.

At Manasquan, a satisfactory purification has been accomplished under the direction of this Commission. At Cape May,

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the nuisance is overcome by pumping the sewage into deep water away from the city, into Delaware bay. In this case, the action was voluntary. The necessity of action has been recognized at Atlantic Highlands, and it is hoped that the local authorities will voluntarily adopt some method of purification.

COPPER SULPHATE EXPERIMENTS.

During the last year experimental use has been made of copper sulphate in the purification of sewage at Vineland. These experiments are under the supervision of the Department of Agriculture of the Federal Government and under the direct charge of Edwin L. Newcomb, who has supervised the work of the local authorities, making reports from time to time. The experiments have been carefully watched by this Commission, and it has made tests and has under consideration further investigation in regard to the results obtained.

The sewerage system of Vineland includes a disposal plant of intermittent sand filtration beds, a full description of which is included in the report of the Secretary hereto annexed. The effluent is discharged into Tarkiln creek, which later joins Parvins Branch which discharges into the Maurice river near Union lake, a large artificial body of water from which the city of Millville draws its water supply. Because of this situation, it is necessary to maintain a high degree of purification of effluent from these beds. The natural conditions are such as to furnish an excellent location for sand filtration beds and these were installed with the approval of this Commission. The purification has been good, although the beds have not received such care as they need, in the judgment of the Commission.

The use of copper sulphate is of great present interest, and especially under the conditions outlined. The reports of Mr. Newcomb, copies of which have been furnished to the Commission, show litmus agar tests for coli bacilli in the effluent after copper sulphate solution had been dripped into the sewage while it passed from a settling bed to the sand filters. He reports that, after several days use, the coli decreased and finally disappeared. The salt was applied at the rate of one part to 150,000 parts of sewage, the proportion being increased

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lately as the temperature decreased. Mr. Newcomb reports the elimination of coli bacilli by this method of treatment, as determined by his analyses. These reports, however, have not satisfied this Commission as yet of the value of this method of treatment. The practical trial is useful and may develop some knowledge of value. The germicidal properties of copper sulphate are already well known. The litmus agar tests alone are scarcely conclusive. Various organisms may produce the color results and, under some conditions, such as the spreading of other organic colonies over coli, the coloring power might be weakened or neutralized. The other tests usually used seem to have been tried only when the acid producing colonies were disclosed by the litmus. It would not be unprecedented if fermentation tubes should disclose coli when agar plates give negative results. Even were these tests more conclusive, judgment on the results must be withheld until the work has been duplicated. Tests made under the direction of this Commission failed to confirm the findings of Mr. Newcomb. The purification of sewage in a sand filter is essentially a bacterial process, and whether such a bactericidal agent as copper sulphate can be always depended on to show such discretionary election in the choice of its victims, that the chemical purification will not be interfered with, is at least open to question.

It is unhappily the custom to exaggerate the importance of such devices, and thus divert attention from the true line of progress. Time is lost and money spent, too often without practical results. Experiments of this kind deserve respectful consideration, but until there has been a full record established by practical operation, approval must be withheld.

The Commission finds as yet no process of purification equal to that of septic treatment, followed by filtration, and with proper attention, the system meets the requirements.

NEED OF SEWERAGE.

A number of large suburban communities in the State still lack all sewerage facilities. Morristown, one of the wealthiest and most thriving of the suburban cities of the northern part of

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the State, is without sewerage, and the need is becoming so great as to constitute a menace to health and to the future prosperity of the community.

The question of protecting the water supplies of Jersey City and Newark from sewage pollution by the cities and towns near the sources is a serious one and filled with difficulty. In the case of Newark, the village of New Foundland is the only menace. The Pequannock river passes through this place and by vigilance the discharge from houses and hotels has been kept from the stream, but the increasing number of houses and the difficulty of proper supervision have made a sewerage system necessary. The city of Newark proposes to provide the place with a water-supply, in case a sewerage system is constructed, but the cost of the latter is regarded as prohibitive by many of the residents. That sewerage, where it is required to protect the health of many thousands should be compulsory, cannot be questioned. That the cost should not be borne entirely by the community to be sewered seems reasonable, provided the main object of the sewerage is the protection of the water-supply. As a rule, these matters can be settled by mutual arrangement, but where obstacles arise there should be some authority to decide as to the relative responsibilities, and it would seem advisable to confer this authority upon the State Sewerage Commission.

The condition in regard to Jersey City is even more serious. There are numerous points of possible pollution. At present the supply is controlled by a private company, but this does not alter the conditions of the problem.

The Commission desires to return thanks for the consideration shown it by the Governor and other State officials in the prosecution of its work.

All of which is respectfully submitted.

CHARLES W. FULLER, *Chairman,*
WILLIAM T. HUNT,
JAMES E. FLEMING,
JOHN H. CAPSTICK,
FREDERICK C. JACOBSON.

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Report of the Treasurer.

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Report of the Treasurer.

To the State Sewerage Commission:

I respectfully submit the following report of the receipts, disbursements and expenditures of the State Sewerage Commission for the fiscal year beginning November 1st, 1904, and ending October 31st, 1905.

The Treasurer has received from the State Treasurer and expended, with the approval of the Governor and of the State Sewerage Commission, $1,965.32 from the fund of $2,000 appropriated by the Legislature of 1904, for rent and necessary expenses of the Commissioners, leaving an unexpended balance of $34.68 returned to the State Treasurer on November 1st, 1905.

The Treasurer has on file vouchers for the money expended.

RECEIPTS.

Received from the State Treasurer:	
November, 1904,	$116 27
1905.	
January,	144 11
March,	134 34
May,	79 95
July,	115 10
September,	301 89
October,	1,073 66
Total,	$1,965 32

EXPENDITURES.

1904.

Nov. 28. For expenses of State Sewerage Commission:

To Robert Barry, agent, for rent to December 31st, 1904,	$70 00	
G. Everett Hill, for engineering services and expenses,	39 87	

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	"The Engineering Record," for subscription,	$3 00	
	Boyd McLean, for postage, railroad fare, etc.,	3 40	
			$116 25
1905.			
Jan. 23.	For expenses of State Sewerage Commission:		
	To Robert Barry, agent, for rent to February 28th, 1905,	$70 00	
	J. W. Harrison, for stationery,	21 65	
	Charles Young, for typewriting,	33 20	
	United Electric Company, for lighting,	3 46	
	Boyd McLean, for postage, telephone and railroad expenses, etc.,	15 80	
			144 11
Mar. 27.	For expenses of State Sewerage Commission:		
	To Robert Barry, agent, for rent to April 30th, 1905,	$70 00	
	William T. Hunt, for telephone and railroad expenses, etc.,	10 00	
	Charles Young, for typewriting,	5 00	
	James Owen, for engineering services,	25 00	
	United Electric Company of New Jersey, for lighting,	4 69	
	Boyd McLean, for railroad expenses, postage, etc.,	19 65	
			134 34
May 29.	For expenses of State Sewerage Commission:		
	To Robert Barry, agent, for rent to June 30th, 1905,	$70 00	
	Boyd McLean, for postage, railroad fare, telephone, etc.,	9 95	
			79 95
July 24.	For expenses of State Sewerage Commission:		
	To Robert Barry, agent, for rent to August 31st, 1905,	$70 00	
	G. E. Hill, for engineering report and expenses,	30 10	
	Charles Young, for typewriting,	10 50	
	Boyd McLean, for postage and telephone,	4 50	
			115 10
Sept. 25.	For expenses of State Sewerage Commission:		
	To Robert Barry, agent, for rent to October 31st, 1905,	$70 00	
	Hoffman Brothers, for printing,	55 25	
	G. E. Hill, for engineering services and expenses,	72 64	
	F. C. Jacobson, for traveling expenses,	11 00	

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	Boyd McLean, for traveling expenses, postage and telephone,	$64 20	
	Charles Young, for typewriting,	28 80	
			$301 89
Oct. 23.	For expenses of State Sewerage Commission:		
	To Richard N. Connolly, for bacteriological analyses,	$400 00	
	Herbert B. Baldwin, for chemical analyses,	400 00	
	George W. Fuller, for report on oyster pollution,	100 00	
	Heywood Bros. & Wakefield Co., for furniture,	44 00	
	Charles Young, for typewriting,	8 50	
	J. W. Harrison, for stationery,	34 79	
	Boyd McLean, for traveling expenses of Commissioners and Secretary, postage, telephone, etc.,	86 37	
			$1,073 66
			$1,965 32

Respectfully submitted,

WILLIAM T. HUNT,
Treasurer.

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Report of the Secretary.

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Report of the Secretary.

To the State Sewerage Commission:

I have the honor to submit the following report of the work of the State Sewerage Commission during the year ending October 31st, 1905.

On Monday, May 1st, 1905, Mr. Charles W. Fuller and Mr. William T. Hunt were respectively elected Chairman and Treasurer of the Commission for one year, to succeed themselves.

At a meeting of the Commission held December 4th, 1905, a communication was received from Mr. William T. Hunt, announcing that he had forwarded to the Governor his resignation from the Commission, to take effect January 7th, 1906.

The following resolution was unanimously adopted:

Resolved, That the State Sewerage Commission express formally its sincere regret that William T. Hunt, Esq., has resigned from its membership. And be it further

Resolved, That the Commission record at this time its appreciation of the interest shown and efficient service done in the lines of its work by Mr. Hunt, whose labors in the Passaic Valley Sewerage Commission, the River Pollution Commission and in this Commission, which he served both as Chairman and as Treasurer, were of the greatest value, and equipped him with such experience that his resignation will result in a distinct loss to the State, to this Commission and to his fellow-members.

As in preceding years, meetings of the Commission have been held on Monday afternoons at its office in Jersey City, and special meetings have been held at other places when necessary.

A detailed statement of the work done by the Commission during the year is hereinafter set forth.

ASBURY PARK.

At a meeting of the Commission held January 9th, 1905, a communication was received from Mr. John L. Coffin, Super-

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intendent of the Department of Water and Sewers of the city of Asbury Park, stating that plans for the purification of the sewage of Asbury Park were being prepared.

At a meeting of the Commission held February 27th, 1905, plans and specifications for changes in the disposal of the sewage of Asbury Park, providing for an intercepting sewer, a septic tank, a pumping plant, and an outlet sewer, were submitted to the Commission on behalf of the city of Asbury Park by John L. Coffin, Superintendent of the Department of Water and Sewers. The plans submitted were approved by the Commission at the same meeting, subject to such conditions of construction, operation and purification as the Commission might from time to time require.

The plans approved provided for the intercepting of all sewage discharged along the beach front by an intercepting sewer running to the north end of the city, where a pumping plant was necessary to raise the sewage sufficiently to obtain a fall for purification by a septic tank. The effluent was to be discharged by a new outlet pipe discharging into deep water.

At a meeting of the Commission held August 28th, 1905, the Secretary reported that he had visited the city of Asbury Park and found that the new outlet sewer had been constructed, but that the proposed septic tank and pumping plant provided for in the plans approved by the Commission had not been constructed and that the crude sewage was still being discharged into the ocean.

ASYLA.

As reported last year, the Commission had communicated to the Board of Chosen Freeholders of Camden county its disapproval of the condition of the sewage purification plant for the county institutions at Asyla.

At a meeting of the Commission held October 2d, 1905, a communication was received from Counsellor George J. Bergen, of Camden, outlining proposed changes in the construction of the disposal plant, including substitution of automatic distribution by means of syphon chambers instead of the tipplers previ-

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ously in use, and inquiring whether the proposed changes would be sufficient to obtain the approval of the Commission.

At a meeting of the Commission held October 9th, 1905, the Secretary was directed to reply to Mr. Bergen's communication that the proposed changes would not bring the plant within the approval of the Commission because the construction of syphon chambers as proposed would cause a sudden discharge of 375 gallons of sewage at one time on the filters, thus increasing the difficulty caused by the too rapid passage of the sewage through the filters; because no provision had been made for the removal of the pipes or drains leading directly from the institutions to the creek without passing through the disposal plant, and because no alterations had been provided for in the construction of the filters to prevent as far as possible the passage of pathogenic germs from the disposal plant to the creek.

At a meeting of the Commission held October 23d, 1905, a communication was received from J. J. Albertson, County Engineer, of Camden county, stating that the only direct discharge pipe from the Camden county institutions at Asyla was used only as a by-pass in case the main was clogged, and suggesting that the Commission should not require its removal, as it was necessary for that purpose.

At a meeting of the Commission held November 4th, 1905, a communication was received from the Bacteriological Sewage Purification Company of New York, the contractors who had constructed the plant, outlining and explaining the changes which it proposed to make at the Asyla plant for the purpose of putting it in proper condition, as follows:

We propose to remove the existing metal tipplers and the concrete trays, in which they move, replacing them with a series of pipe branches, to distribute the sewage into troughs on the tops of the beds. These troughs will consist of heavy galvanized iron, or wrought iron, or steel channels, approximately four inches wide, with sides one and three-quarter inches high. These channels are to replace the existing wooden troughs, and are to be carefully laid over the beds, supported on wooden beams. The beds will be carefully overhauled, refilling all holes which have been washed out, and resurfacing throughout. The system of distribution will be changed entirely by means of the introduction of three siphon chambers, provided with three-inch automatic sewage siphons. The first of these chambers will receive the tank effluent and will discharge intermittently into a diverting chamber (a casting pro-

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vided with a two-way gate), from which diverting chamber it will pass to either of the primary beds, over which it will be distributed by means of the branch pipe and channels above described. It is proposed to arrange this siphon chamber of sufficient size so that it will discharge about once every ten minutes. The underdrains from the first set of beds will be connected with two other siphon chambers, set at a lower level, from which the effluent will discharge in the same manner over the secondary set of beds.

The idea is to restore the plant to its proper working order and to install in the place of the unsatisfactory tipplers an automatic siphonage device, which will work without movement, and which will not tend to destroy or impair the beds by shock or jar. We feel very sure that when this work is done it will bring the plant to a high state of efficiency.

Further action in regard to the Asyla plant was postponed until a test of the plant could be made after the completion of the changes proposed by the Bacteriological Sewage Purification Company.

ATLANTIC HIGHLANDS.

At a meeting of the Commission held October 2d, 1905, a communication was received from William M. Roberts, Mayor of the borough of Atlantic Highlands, inquiring as to the best method of the disposal of the sewage of that borough. By direction of the Commission, the Secretary replied, suggesting that probably consultation with a competent engineer would be the best action on the part of the municipal authorities, and suggesting that special inquiry be made into the subject of treating the sewage by means of a septic tank, as being the most practical plant the Commission could suggest, and recommending that some action be taken by the borough for the purpose of protecting its beach front from the deposit of solid matters discharged in the sewage.

BORDENTOWN.

At a meeting of the Commission held September 11th, 1905, plans for a sewer extending from Park street and discharging into Crosswick's creek were submitted to the Commission on behalf of the city of Bordentown by D. R. Brown, Chairman of the Sewer Committee of the City Council, together with a petition from the city authorities for the approval of the plans.

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The following resolution was adopted by the Commission:

Resolved, That the plans submitted by the city of Bordentown for a sewer extending from Park street and discharging into Crosswick's creek be approved, subject to such conditions of construction, operation and purification as may be required from time to time by this Commission; and with the further condition that if, at any time, in the judgment of this Commission, it becomes necessary to purify the sewage to be discharged in order to prevent a nuisance in Crosswick's creek or the Delaware river, such purification plant as this Commission shall then approve shall be required.

The construction of the sewer provided for in the plans submitted would provide a remedy for the pollution of Thorntown creek, which runs through the city of Bordentown, discharging into Crosswick's creek. The pollution of Thorntown creek was the subject of complaint previously made to the Commission that the water-supply of the city was being polluted. The Commission decided not to interfere in the matter as the municipal authorities were working to procure a proper solution of the difficulty. This has been done by securing a new source of supply by the city and the proposed removal of the Thorntown creek pollution by the plans approved.

At a meeting of the Commission held December 18th, 1905, a report was received from D. R. Brown, Chairman of the Sewer Commitee of the City Council, stating that the right of way for the sewer across Bonaparte Park to Crosswick's creek had been secured and that the city authorities were engaged in perfecting plans for the execution of the work of laying the sewer.

BURLINGTON.

At a meeting of the Commission held October 23d, 1905, the Secretary reported that he had visited the sewage disposal plant at Burlington; that the plant was producing an effluent of excellent appearance, though the septic tank was overflowing through the overflow pipes, and no scum had formed, and the disposal beds were overgrown with weeds; that a conference had been had with the representatives of the Burlington Sewer Company, and suggestions had been made for the improvement of these conditions.

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At a meeting of the Commission held December 4th, 1905, a report was received from W. N. Cooper, Superintendent of the Burlington Sewerage Company, stating that the sewage disposal beds had been cleared of weeds and placed in good order, and that the two overflow pipes from the septic tanks had been closed, so that all of the effluent passed from the main discharge pipe, and that this has increased the amount of scum in the tank.

CAPE MAY.

At a meeting of the Commission held August 21st, 1905, the Secretary reported that he had visited the city of Cape May on August 16th, 1905; that the city, in conjunction with the Cape May Real Estate Company, was building sewers to drain both the old part of the city and the part now being constructed by the Real Estate Company to a pumping station at a central point, from which the sewage was discharged into Delaware bay through a force main; that the plans for this work had been adopted and the work commenced previous to the act extending the jurisdiction of this Commission to seaside plants.

At a meeting of the Commission held September 18th, 1905, plans of the sewers and pumping station constructed in the city of Cape May were received from DeWitt D. Barlow, C.E., and placed on file.

The plans for the sewers which are now being constructed provide for the removal of all the sewage of Cape May to a point about three miles distant in the deep water of Delaware bay, where the current is sufficient to carry it away without any nuisance.

COLLINGSWOOD.

At a meeting of the Commission held October 9th, 1905, a report of the condition of the sewage disposal plant at Collingswood, showing that the recommendations made the previous year by the Commission for the improvement of the plant had not been carried out, was received and the Secretary was directed to

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notify the authorities of the borough to show cause at the next meeting of the Commission why they should not be required to place the plant in proper condition.

At a meeting of the Commission held October 16th, 1905, a communication was received from Richard T. Collings, Mayor of the borough of Collingswood, and President of the Collingswood Sewer Company, stating that the company had been under heavy expenses and for that reason had not repaired the sewage disposal plant.

On motion, the Secretary was directed to notify the Collingswood Sewer Company that unless the disposal plant was at once put into proper shape, the matter would be placed in the hands of the Attorney-General.

At a meeting of the Commission held October 23d, 1905, the Secretary reported that he had visited the sewage disposal plant at Collingswood and consulted with Richard T. Collings, the President of the Collingswood Sewer Company; that the plant was in the same improper condition previously reported, and was not doing efficient work; that Mr. Collings agreed to have the changes, recommended by the Commission, made within one month.

At a meeting of the Commission held December 4th, 1905, a communication from Richard T. Collings,, President of the Collingswood Sewer Company, stating that the lower beds of its sewer disposal plant had been renovated and the drainage ditch to the creek cleaned out; that the water was backed up into the plant by several carloads of stones placed in the channel of the creek, under the bridge of the Atlantic City Railroad Company, and requesting that the railroad company be notified to remove the obstruction, was received and filed.

On motion, the Secretary was directed to communicate with the General Superintendent of the Atlantic City Railroad Company, asking whether the statements of the Collingswood Sewer Company were correct, and, if so, whether the stones could be removed.

The Secretary was further directed to communicate with the Collingswood Sewer Company, stating that its report was en-

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tirely unsatisfactory; that no reference had been made to the manner of pumping sewage, although it had been explained that the pumping should be regular every day; that examinations made by the Commission showed that no change had been made in the manner of pumping; that the clearing of the beds had been extremely superficial; that the beds had been gullied so that the sewage runs across the top without any purification, and that there was no indication on the plant of the cleaning of the outlet and the lower part of the lower beds, which was reported; that the only substantial work, as shown by the examinations, was the removal of the material from one of the upper beds for cleaning, and that unless steps were immediately taken to put the plant in proper shape, the Commission would find it necessary to take proceedings by injunction to prevent the use of the sewerage system.

HACKENSACK RIVER.

At a meeting of the Commission held May 1st, 1905, a communication was received from William J. Parker, Secretary of the Bogota Boat Club, complaining of the pollution of the Hackensack river by waste oils from the gas plant of the Gas and Electric Company of Bergen County at Hackensack. The Secretary was directed to investigate the complaint.

At a meeting of the Commission held May 22d, 1905, the Secretary reported that he had investigated the complaint that waste oil was allowed to escape from the gas plant at Hackensack, polluting the Hackensack river, and found that oil was allowed to escape. The Secretary was directed to notify the gas company to cease polluting the river.

At a meeting of the Commission held June 5th, 1905, a communication was received from E. J. Donahue, stating that the Hackensack plant had been leased by the Public Service Corporation, and that it would prevent the escape of gas oil into the Hackensack river. The Secretary was directed to request a report as to the action taken to prevent the escape of oil.

At a meeting of the Commission held June 26th, 1905, a communication was received from E. J. Donahue, stating that

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practically no drainage was leaving the works and entering the river, and that the tar and oil complained of came from the swampy ground along the river edge, where it was deposited the previous year by a freshet which broke the dyke around the lagoon which acts as a catch-basin; that it was a question whether extreme care had been used in seeing that the separator system worked properly, as more or less tar and oil found its way to the lagoons; that a little matter was found issuing out at the base of the lagoon at various points, and that the banks had been opened up in a number of places,and fine ashes and clay put in to prevent leakage; that one of the lagoons is very large and the walls built of old brick and clinkers, and that it would be difficult to prevent all seepage from that one; that soundings of this lagoon showed only a little scum of tar on the bottom, not sufficient to enable it to be removed by either a pump or dredge; that all residual tar and oil was valuable, and that efforts were being made to prevent material of this nature leaving the plant; that, at the present time, there was no material leaving the works which was detrimental to the river, and that the company felt sure there would be no more complaints of this pollution. On motion, the Secretary was directed to notify the Bogota Boat Club of the action taken by the Public Service Corporation, and to request that notice be given of any further cause for complaint.

At a meeting of the Commission held August 21st, 1905, a further complaint was received from William J. Parker, Secretary of the Bogota Boat Club, of the pollution of the Hackensack river by waste oils from the Hackensack gas plant. The Chairman reported that he had communicated with the Public Service Corporation, in relation to the complaint, and had requested a report from it on the matter.

At a meeting of the Commission held August 28th, 1905, a communication was received from E. J. Donahue, engineer of the Public Service Corporation, reporting that the following work had been done to prevent objectionable drainage from the Hackensack gas works; that the method of separating the tars and oils from the excess water had been changed; that the system in use was so perfect that no particle of tar entered the lagoons, which are located on the property of the Company; that a leak

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had been found and repaired in one of the drain pipes, which also prevented tar and oil matter getting into the river; that about fifteen per cent. of the retaining wall about the lagoon had been rebuilt to prevent seepage; that at least six times a personal examination had been made, during the previous thirty days, by Mr. Donahue, and that he had failed to find any tar or oil floating on the top of the water in the river, for which the Company was responsible; that it was admitted that the marsh ground, north and south of the gas works, contained a certain amount of tar, which was forced there by the flood that occurred the previous year, but that there was no way of getting rid of this unless there was another freshet, and that, with all the precautions which had been taken, the company thought that there would be no more complaints of pollution from the gas works.

HADDONFIELD.

At a meeting of the Commission held October 9th, 1905, a report of the condition of the Haddonfield sewage disposal plant, showing that it was not in proper condition, was received, and the Secretary was directed to notify the authorities of the borough of Haddonfield to show cause at the following meeting of the Commission why they should not be required to put the disposal plant in proper condition.

At a meeting of the Commission held October 16th, 1905, J. Morris Roberts, Mayor of the borough of Haddonfield, appeared before the Commission in response to its order, and explained that the sewage disposal beds at Haddonfield had recently become flooded, and that the borough was prepared to put them in proper condition.

On motion, the following resolution was unanimously adopted:

Resolved, That the borough of Haddonfield be required to remove the top dressing of the sand filters of its sewage disposal plant, and to replace the same with good, clean sand, and to clear the underdrains of the sand filters, and to instruct the superintendent of the disposal plant to have the beds cleaned and the underdrains kept clear of obstructions.

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At a meeting of the Commission held October 23d, 1905, the Secretary reported that he had visited the sewage disposal plant at Haddonfield and had consulted with the Mayor, J. Morris Roberts; that the plant was in good shape, excepting the filter beds, which were flooded, and from which the effluent was passing too slowly; that the underdrains were partially clogged with clay and sewage fungi, and that the beds needed new top dressing; that Mayor Roberts stated that the changes required by the Commission would be made by the borough.

HOLLY BEACH.

At a meeting of the Commission held January 23d, 1905, plans for a sewage system for the borough of Holly Beach, providing for the direct discharge of sewage into Beach thoroughfare and Post creek, by three outlet pipes, were submitted to the Commission by William H. Boardman, C.E., on behalf of the borough.

On motion, the plans submitted on behalf of the borough of Holly Beach, providing for the direct discharge of sewage into Beach thoroughfare and Post creek, were approved, subject to such conditions of construction, operation and purification as the Commission might from time to time require.

At a meeting of the Commission held December 15th, 1905, a report was received from William H. Boardman, C.E., that the last section of the sewerage system at Holly Beach was about completed; that two other sections were completed early in the summer, and have been in use since about August 1st; that up to the present time the system worked satisfactorily in every way; that no nuisance was caused by the discharge of sewage into the channel of Beach thoroughfare.

JAMESBURG.

At a meeting of the Commission held May 1st, 1905, the Secretary reported that a sewage disposal plant had been installed at the State Home for Boys, at Jamesburg, without sub-

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mitting the plans for the plant to the Commission for its approval. The Secretary was directed to communicate with the trustees of the State Home for Boys, requesting that the plans of the sewage disposal plant at the State Home for Boys, at Jamesburg, be submitted to the Commission for its approval.

At a meeting of the Commission held June 19th, 1905, plans of the sewage disposal plant at the State Home for Boys, at Jamesburg, were received from Stuart K. King, clerk of the Board of Trustees, and placed on file. On motion, the Secretary was directed to engage G. E. Hill, C.E., to examine and report on the plans for the disposal of the sewage of the State Home for Boys, at Jamesburg.

At a meeting of the Commission held July 10th, 1905, a report was received from G. E. Hill, C.E., on the sewage disposal plant at the State Home for Boys, at Jamesburg, and the Secretary was directed to send a copy of the report to the trustees of the Home, with the suggestion that the recommendations therein contained be adopted. The report was as follows:

NEW YORK, July 6th, 1905.

To the Honorable the State Sewerage Commission of New Jersey:

GENTLEMEN—In accordance with your instructions I visited to-day the New Jersey State Home for Boys, at Jamesburg, and examined its system of sewage disposal. I beg to submit the following report:

The institution lies south and east of Lower Jamesburg, between the Matchaponic brook and the Manalapan brook, both tributaries of South river, which empties into the Raritan. A tiny rill, which disappears in dry weather, runs east and north through the State Farm and skirts the northern edge of the disposal field. It was flowing to-day at a rate of perhaps ten to fifteen gallons per minute.

The number of boys in the Home is constantly changing, but it ranges between 430 and 470. The attendants and servants number about fifty or sixty. The water consumption is about 35,000 gallons per day. The flow is fairly uniform, for the laundry operates six day in the week. In cool weather Saturday night is "bath night," but in summer the boys bathe and swim in a small lake.

All the buildings that produce sewage are connected with the general system. The hospital (now empty) has ample facilities for the isolation of infectious cases. A trained nurse is in attendance, and all discharges from the sick are disinfected before they enter the sewers. The sewage is collected by one line of eight-inch pipe, which delivers to the disposal plant about 500 feet northeast of the nearest building of the group.

The flow—which is typical institutional sewage, considerably stronger than average municipal sewage—enters a small semicircular gate-chamber, whence

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it is turned, by a swinging wing-gate, to either one of two concrete flush-tanks, built side by side. At the inlet end of each tank is a coarse screen, which retains the larger solids. These are raked out from time to time and the rakings are buried. Each tank is twenty-two by fourteen feet in area, with an effective depth of three feet, holding, approximately, 7,000 gallons. Each is discharged by an automatic siphon. A separate outlet from the bottom, controlled by a valve, is provided for drainage. This outlet delivers into the channel that carries the normal siphon discharge. The floor of each tank is flat, or nearly flat. There is, therefore, little or no "scour" toward the siphon, and sludge accumulates. One tank is used for several consecutive weeks, while the other lies idle. When the flow is turned to the second tank the drainage valve of the first is opened, and the sludge, when dry enough to handle, is shoveled out and buried.

Both siphons and both drainage outlets discharge into a channel of twelve-inch vitrified half-pipe, which skirts the southern and western edge of the disposal field and delivers to it, at intervals of about thirty feet, through fourteen branch channels. The flow is diverted, in a measure, by sheet-iron stop-gates inserted in cracks between the channel-pipes. The field, however, is not divided into separate tracts, and a trench connects the three principal outlets, so that, no matter which of the three main gates is open, the same land receives the sewage.

The field is an irregular hexagon with three right angles (a parallelogram, save for one side broken by two angles), containing about two acres. The large-scale plan of the field (bearing the name of the constructing company and included in the roll of drawings given me) calls for three acres. The general plan, however, shows a field without figured dimensions, but scaling as about an acre and a half. Neither plan shows the actual shape of the tract.

The land slopes rather sharply to the small stream bounding its lower edge. The surface has never been properly graded, and much of the area is occupied by knolls and ridges, which never receive any sewage at all. The soil is a mixture of sand and clay, with clay predominating. Absorption, naturally slow, is hindered by the choking of the surface with gelatinous and greasy solids, which escape freely from the flush-tanks. The field is underdrained, in part at least, by tile lines about twenty-feet apart, each delivering independently to an effluent ditch, which runs across the lower edge of the tract and delivers into the stream at the northeast corner. But six tile outlets could be found.

The disposal field has never been divided into beds, and the whole effective area is saturated practically all the time. No provision has been made for checking the flow of sewage or distributing it in its descent. A very large part of the liquid, therefore, flows rapidly over the surface, in channels which the wash has cut, and discharges directly into the stream without purification. Near the eastern edge is a long gully and a deep washout, apparently caused by storm-flow, for it showed no trace of sewage save at its lower end.

When I arrived one flush-tank was empty and clean. The other contained about twenty-six inches of sewage covered with a layer of typical sewage scum about four inches thick. Maggots and worms were abundant, and the crust of the scum was covered with flies. The screen was completely choked with paper, rags and sludge, and the sewage was flowing over its edge,

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instead of through it, The drain-valve was partly open, and a stream, a little less in volume than the inflow, was passing continually to the field, keeping the ground near the outlets saturated. This constant discharge seems to be the regular practice, for I found exactly similar conditions at the time of a previous visit. At my suggestion the valve was closed. The water in the tank rose to the full line, and the siphon began to discharge in about half an hour. The sewage spread rapidly over the low area usually flooded, and the underdrains began running at once, while a strong stream ran over the surface through a channel into the brook.

Underdrain *a* delivered a very small stream, clearer than any of the other discharges except that from *e*, but not by any means pure. Underdrain *b* delivered a larger volume, turbid and blackish gray in color. Underdrain *c* ran a little less freely, and the effluent was somewhat clearer. Underdrain *d* poured out a large volume of black water—practically unpurified septic sewage. *e* was barely wet with clear water, and *f* was dry. Some of these underdrains are choked, and some, particularly *b* and *d*, are undoubtedly in direct communication with the surface, through sink-holes.

The channel of the brook is irregular and obstructed with rubbish and vegetable growth. Near the outlet it is heavily lined with Beggiatoa Alba and other sewage fungi. The water below the field is black and foul, but it clears so rapidly that two thousand feet away it is no longer offensive, though of course it is unfit for domestic use or for watering cattle.

There is little odor from the field, but the scum on the flush-tank is very objectionable, not only to sight and smell, but because of the danger of the transfer of pathogenic germs by the flies that swarm on it.

I advise—

(1) That the line to the existing works be cut and a covered septic tank be installed to retain and digest the solids. This tank should have ample storage capacity for sludge (for the percentage of solids is abnormally high), and yet it must not detain the sewage long enough for putrefactive tendencies to assert themselves. A tank properly constructed will digest the rags and paper which now require mechanical removal, and will relieve the flush-tank of the sludge and scum nuisance.

(2) That the drain valves be closed save when a flush-tank is to be drained and thrown out of commission. The discharge to the field should be intermittent for two reasons, first, in order that the flow may be full and strong enough to flood the tract in use and give every portion of it an opportunity to do its duty, and, second, in order that the land may drain and aerate between applications.

(3) That the underdrains be examined, cleaned and relaid where necessary.

(4) That the field be graded in terraces (a survey and calculation will be necessary to determine the best size and number), each banked at its lower edge with a barrier of cinders, sufficiently wide and high to effect the flooding of the entire surface, and yet porous enough to permit free drainage after the flooding. The slope is too steep for satisfactory use of the field as a single plane surface.

(5) That the field be divided by embankments into three tracts, for alternate use, and that the arrangement of distributing gates be modified so as to make this division effective.

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(6) That the effluent channel and the bed of the brook be straightened and cleared.

Respectfully submitted,
(Signed) G. EVERETT HILL.

GARWOOD.

At a meeting of the Commission held December 11th, 1905, a report was received from Volney Winslow, Mayor of the borough of Garwood, stating that the borough engineer was preparing plans for the purpose of sewering the borough and was also preparing an estimate of the probable cost, and that the report of the engineer would probably be submitted at the next meeting of the borough council.

LAKEHURST.

At a meeting of the Commission held April 3d, 1905, plans providing for a change in the location of the filtration beds of the sewage disposal plant at Lakehurst, were submitted to the Commission by Albert A. Leroy.

On motion, the plans submitted were approved, subject to such conditions of construction, operation and purification as this Commission might from time to time require.

At a meeting of the Commission held November 20th, 1905, a report was received that no actual construction had yet been commenced on the new beds provided for in the plans approved by the Commission.

LEONIA.

At a meeting of the Commission held April 3d, 1905, Dr. J. T. Wyckoff, of the Board of Health of the borough of Leonia, consulted with the Commission in reference to sewerage for part of the borough of Leonia.

At a meeting of the Commission held April 10th, 1905, plans for a sewerage system for part of the borough of Leonia and a certified copy of a resolution of the council of the borough

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of Leonia permitting the use of the streets of that borough by the Northside Sewer Company, were received from Dr. J. T. Wyckoff, and placed on file.

On motion, the Secretary was directed to inform Dr. Wyckoff that a formal application of the Northside Sewer Company for approval of the plans should be made, and that in the opinion of the Commission, the plans should provide for the direct discharge of sewage into Overpeck creek.

At a meeting of the Commission held April 17th, 1905, application of the Northside Sewer Company of Leonia for the approval of the plans for a sewerage system for part of the borough of Leonia was received and filed. Willard Cass, Borough Engineer of Leonia, Dr. J. T. Wyckoff, of the Board of Health of Leonia, and Harry Stark, Director of the Northside Sewer Company of Leonia, appeared before the Commission and explained the plans of the Northside Sewer Company.

On motion, the plans of the Northside Sewer Company of Leonia, for sewers for part of the borough of Leonia, were approved subject to such conditions of construction, operation and purification as the Commission might from time to time require, and with the further condition that the outlet of the proposed sewers be extended to the bend in Moore's creek, two hundred feet west at right angles from the tracks of the Northern Railroad of New Jersey.

On motion the Secretary was directed to notify the Northside Sewer Company of Leonia that the approval of its plans was subject to the future requirement of purification if, in the judgment of the Commission, it became necessary to prevent a nuisance in Moore's creek, Overpeck creek or the Hackensack river.

MADISON.

At a meeting of the Commission held December 18th, 1905, a report was received from C. E. Cook, Secretary of the Board of Health of Madison, stating that plans and specifications had been prepared for a sewage disposal plant for Madison, but that the authorities were in doubt as to the best place to locate the

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plant, as the lowest place in the borough is at the point where the borough water wells are located, and that probably some action would be taken in the matter during the coming year.

MANASQUAN.

At a meeting of the Commission held August 28th, 1905, the Secretary reported that he had visited the borough of Manasquan and examined its sewerage system on August 23d, 1905; that the system had been in satisfactory operation for several months, but that samples of the effluent could not be obtained because the tide backed up to the level of the septic tank; that the effluent was practically free from solids, and that there had been no nuisance or complaint because of the system.

MEDFORD.

At a meeting of the Commission held March 27th, 1905, a communication was received from Edward B. Reeve, of Medford, Burlington county, complaining of the lack of sewerage facilities in Medford. The Secretary was directed to notify the local Board of Health that the complaint had been received and was referred to it, as the Commission lacked jurisdiction.

MERCHANTVILLE.

At a meeting of the Commission held September 18th, 1905, two communications from A. W. MacCallum, of Merchantville, in relation to the adoption of plans for a sewerage system for the borough of Merchantville, were received and filed.

At a meeting of the Commission held October 20th, 1905, the Secretary reported that an engineer had been engaged and that plans were being prepared for a sewerage system for the borough of Merchantville.

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MILLVILLE.

At a meeting of the Commission held July 24th, 1905, a communication was received from the Board of Health of the city of Millville complaining that owners of private sewers discharging into the Maurice river had not connected with the sewerage system of the city.

The Secretary was directed to request further information and the names of the parties using the private sewers. No reply was received from the Board of Health.

MOORESTOWN.

At a meeting of the Commission held October 23d, 1905, the Secretary reported that he had visited the sewage disposal plant at Moorestown, and had consulted with Mr. E. C. Worrell, superintendent in charge; that the plant was in good condition, excepting that sludge had accumulated in the grit chamber, and that the passage of sewage between the sections of the septic tank was too rapid, due to the smallness of the connecting weirs, and that the plant was kept in good condition.

At a meeting of the Commission, held November 20th, 1905, a communication was received from Alexander Potter, the designing engineer, suggesting that better results could be obtained at the Moorestown sewage disposal plant by cleaning the grit chamber more frequently and by using each of the contact beds every day.

The Secretary was directed to request a report from the superintendent in charge of the Moorestown sewage disposal plant as to the frequency of cleaning the grit chamber and of using the contact beds.

At a meeting of the Commission held November 27th, 1905, a communication was received from E. C. Worrell, superintendent of the Moorestown sewage disposal plant, reporting that it was the practice to clean the grit chamber of the disposal plant every six months and to use each contact bed for one day and allow it to rest for three days.

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On motion the Secretary was directed to suggest to E. C. Worrell, superintendent, that the grit chamber of the Moorestown sewage disposal plant be cleaned often enough to keep it free from any accumulation of solid matter, and that each of the contact beds be used a part of each day.

MORRISTOWN.

At a meeting of the Commission held December 4th, 1905, the following report as to the progress of plans for a sewerage system for Morristown was received from Charlton A. Reed, Mayor of Morristown:

In regard to the provision of a sewerage system for Morristown, I would state that there is no project on foot at the present time for a sewerage system.

You may be aware that some time ago, on the petition of some of our citizens, a commission was appointed by the Judge of the Circuit Court here to investigate the matter of making recommendations. This commission consisted of Mr. Charles W. Ennis, Mr. Thomas W. Cauldwell, Mr. Robert D. Foote and the late Mr. William B. Skidmore. These gentlemen made a report to the board of aldermen in which they failed to agree or recommend anything for the Board's action. That, under the statute, as I understand it, left the matter in the same situation it was before the appointment of the Commission. I have concluded to bring this matter to the attention of the board of aldermen of this town at their next meeting.

The provision of the law is that petition must be made to the Board, and the Board present the petition to the judge of the Circuit Court of this district. Any recommendations I make to the Board can have no other effect, as I view it, than to call public attention to the matter, and perhaps incite some of our citizens to present the requisite petition.

NEW LISBON.

At a meeting of the Commission held October 30th, 1905, a report of the condition of the sewage disposal plant of the Burlington county institutions at New Lisbon was received, showing that the plant was not in proper condition. On motion the Secretary was directed to engage G. E. Hill, C.E., to make a report on the engineering features of the sewage disposal plant of the Burlington county institutions at New Lisbon.

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At a meeting of the Commission held November 13th, 1905, a report on the sewage disposal plant of the Burlington county institutions at New Lisbon was received from G. E. Hill, C.E., and the Secretary was directed to send a copy of the report to the Board of Chosen Freeholders of Burlington county with the suggestion that the recommendations therein contained be adopted. The report was as follows:

NEW YORK, November 13th, 1905.

To the Honorable the State Sewerage Commission of New Jersey:

GENTLEMEN—On November 9th and 10th, without previous announcement of my coming, I visited two Burlington county institutions, the Hospital for the Insane and the Almshouse, both situated at New Lisbon, N. J., but under separate management.

The former has, at present, 148 inmates and a staff of about twenty-five. The water supply is taken from the general local plant, and the service is unmetered. The per capita consumption is unknown, but it is not large. Twelve automatic flush-tanks contribute about 3,500 gallons of water per day to the sewers. The flow is distributed with fair uniformity throughout the week. Mondays, Tuesdays and Wednesdays are always "wash days," but the laundry is more or less busy on all week days. Bathing is so regulated that the amount of bath water is practically the same each day for five days in the week.

Formerly all the sewage from the institution ran to an open cesspool or settling tank (15x6) in the field behind the buildings. A baffle-board retained the scum and the liquid overflow passed directly to the grassed surface, which was used as an irrigation field, though without proper arrangements for distribution of intermittent application.

In the spring of 1903 a new system of sewage disposal was introduced. A new outfall sewer was laid from manhole A, and into this was diverted the sewage from all the buildings *except the laundry*. The laundry wastes still discharge, through a slop-sink connection outside the building, into the old sewer and thence into the cesspool. The overflow from this cesspool joins the effluent from the sewage disposal plant in junction chamber E.

When the new line from manhole A was built the old pipe was bricked up and cemented, but not removed. The portion showing above the water line seems to be tight; the rest could not be examined without damming the incoming water and emptying the manhole. It is possible that a small quantity of sewage still leaks into the old line, but the amount escaping cannot be serious.

The disposal plant, which now cares for the sewage from the main buildings, consists of:

(1) A brick screen chamber (5x5), fitted with a horizontal screen of one-inch mesh just below the level of the invert of the incoming sewer. From this chamber, below the screen, a pipe leads the sewage to

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(2) A circular brick septic tank, with a working depth of five and a half feet, and covered with a wooden roof. Two iron pipes, set at the same elevation and drawing from below the surface through submerged elbows, lead the sewage from this tank to

(3) A single filter-bed (60x30) in unlined earth excavation, without partitions, filled to a depth of from three and a half to four feet with slag, of three sizes in horizontal strata, the coarsest at the bottom. The effluent from the septic tank is fed to the filter by two wooden V troughs bedded in the surface slag, and the filtrate is collected by three lines of four-inch underdrains, which lead to a common outlet controlled by a valve about twenty-five feet below the lower edge of the bed. It is evident that the filter is intended for use as a contact-bed, the alternate flooding and emptying being controlled by the hand valve.

A ten-inch vitrified pipe leads the effluent from the filter, through manholes C and D to the junction chamber E, where the effluent from the old cesspool enters, and then carries the mixture to an outlet in the open ditch at F. This ditch traverses the field, passes under the road, and then parallels it, receiving as it goes the drainage from the Almshouse property, and delivers into Budd's Run, a tributary of Rancocas creek. The surface and ground water flow at the time of my visit was very small.

Although the disposal system was getting rid of the sewage without offense to the senses, it was not operating as it should.

The floor of manhole A has no channels to confine the flow and maintain transporting velocity, but the sewage spreads over the entire bottom area and deposits its solids. So great was the accumulation that the inlet pipe was dammed to its crown. No more solids could escape, and the water, evidently backed up until under considerable head, squirted out around the perimeter in thin sheets. Curved channels, corresponding in section to the pipes and smoothly plastered, should lead from the two sewer inlets to the outlet, and the benches—outside of the channels—should be built up with concrete and neatly finished. This will make the manhole self-cleansing.

The screen-chamber also was badly choked. No portion of the screen could be seen, and the accumulated paper, rags and other solids choked the inlet pipe. The attendant said the screen-chamber was cleaned "once or twice a week." If the solids consisted of toilet paper and other suspended matter found in normal sewage, the screen could be removed and the whole flow sent to the septic tank. The sewers, however, do such a large freight and express business in newspapers, clothing, brushes and other articles of commerce (a condition irremediable, because of the irresponsibility of the inmates), that mechanical removal and destruction is wise. The screen, however, should be cleaned daily, and the rakings buried as soon as removed. At present they form a mound of considerable size beside the chamber.

The septic tank is working well. The effluent from it contains very little suspended matter, and soundings showed that the accumulation of sludge was slight. There is little or no crust on the surface, but this is doubtless due to the fact that the waste of grease is small, and that what little does reach the sewers is caught by the accumulated solids in manhole A and the screening chamber.

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The filter-bed was clean and odorless, but the sewage overflowing from the carrier troughs disappeared as it fell, and evidently went straight to the bottom, out of the underdrains, and through the open controlling valve to the outlet. One attendant told me that he flooded the bed "occasionally;" another told me that the valve was closed "once or twice a year." Save at long intervals, no attempt is made to retain the sewage in the bed for bacterial change, nor is the filter made to "breathe" by the alternate rise and fall of the liquid. Any change in the sewage affected by passage through the filter must be slight. If the filter be operated as a contact-bed, the valve being closed as soon as the filter is empty, and opened again when it is filled, the character of the effluent will undoubtedly be improved. This, however, will call for constant attention. Moreover, the sewage entering while the bed is draining will not have detention sufficient for much purification, and the lower strata of the bed will be imperfectly aerated. The original plan showed two filter-beds, side by side, evidently for alternate use. But one has been built. I advise that the other be constructed, and that the outlet of each be controlled by an automatic timed siphon or air-lock. Until this change can be made, the hand valve should be used to secure alternate filling and emptying of the bed.

The brick walls of the junction chamber E are disintegrating. They should be taken down, so far as they are unsound, rebuilt and plastered on the outside. The filling around the chamber, to the depth of two feet, should be of broken stone, to prevent heaving by frost, the rubbish should be cleared away and the ground regraded so as to shed water.

A drainage swale terminates in a sink-hole close beside the end of the outlet pipe, and the escaping effluent, which is far from pure, mixes with the standing water in this hole. The hole should be filled, after laying a short tile line to carry through it the surface drainage which runs to this point. The channel of the open ditch should be cleared of weeds and rubbish.

I advise further that the old sewer and cesspool be abandoned, and that the laundry be connected with the new main sewer by a line leading from the outside sink to manhole B.

There is no efficient systematic sterilization of clothes and bedding, although some of it at times is soiled with excretal discharges. The Superintendent expressed the hope that a suitable sterilizer would soon be installed.

The Burlington County Almshouse contains about one hundred inmates and thirty attendants. The building is very old, in bad repair and devoid of modern conveniences. The plumbing—or what passes for plumbing—is a disgrace to the State. Indoor closets have been provided only for the sick and disabled. About forty people use them. The rest, including infirm old men and women, are compelled to go to outdoor privies. Of these there are four—mere board shacks over sand floors. The liquid excreta have saturated the ground behind all four and are flowing out over the road. All laundry work is done in portable tubs; the wash-water is spilled on the ground behind and close to the house. It collects in a sink-hole, and the ground around this is continually saturated.

The soil pipe which carries the kitchen-wastes and the flow from the few other plumbing fixtures ends in a circular settling basin, five feet in diameter

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and two and a half feet deep. This chamber is cleaned out "about once in four or five weeks." The sludge is piled on the ground beside it until a cartload has accumulated. It is then hauled away and used as manure.

The sewage overflows from this settling basin into a second well of the same size and passes thence directly to a drainage ditch in the cow pasture, from which forty-seven cows drink perforce. Rank pollution is apparent at a glance. The milk from the cattle is more than sufficient for the needs of the institution and some of it is sold. At the eastern edge of the pasture the filthy stream is somewhat diluted by the entrance of a lateral ditch carrying a small amount of ground and surface water. The field is so large that the ditch-trickle almost reaches the dignity of a brook before its confines are reached. As it goes, the water improves so rapidly that it is entirely free from offence before it joins the roadside ditch carrying the effluent from the disposal works of the Hospital for the Insane.

The wastes delivered to the stream, though small in volume, are practically crude sewage. Some method of treatment should be adopted; but any appropriation made for its installation should certainly include funds for the reconstruction of the whole drainage system of the institution. The unsanitary conditions in and around this home of one hundred and thirty people are crying noisily and noisomely for relief. One thing can be done and *should* be done at once. The polluted stream should be fenced off and some other water supply provided for the cattle.

Respectfully submitted,

(Signed) G. EVERETT HILL.

NEWTON.

At a meeting of the Commission held May 29th, 1905, a communication was received from Messrs. Williams and Whitman, Civil Engineers, in relation to plans for a sewage disposal plant for the town of Newton.

At a meeting of the Commission held June 5th, 1905, plans and specifications for a system of sewers and two sewage disposal plants for the town of Newton were submitted to the Commission by Messrs. Williams and Whitman, with a request from the authorities of the town of Newton that the plans be approved.

On motion the plans submitted by the town of Newton for a system of sewers and two sewage disposal plants were approved, subject to such conditions of construction, operation and purification as the Commission might from time to time require.

At a meeting of the Commission held December 18th, 1905, the following report on the condition of the sewerage system of Newton was received from Williams and Whitman, Engineers:

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In accordance with your request, we take pleasure in reporting the general conditions of the sewerage system and disposal plants at Newton.

Contracts were awarded some time ago to Messrs. Allen &. Wolff for the sewerage construction, and to Hinman & Sproull for the construction of the the sewage purification plants.

The design of the sewerage system divides the town into two areas—one discharging into the Clinton street purification plant and draining the larger portion of the town, and the other draining into the Sparta street purification plant situated on the Railroad Company's property beyond the silk mills.

The construction of the Clinton street system has progressed considerably—the main business portion of the town and a considerable portion of the better residence district having been completed. As there were a number of private rights of way necessary, as well as the property for the two disposal plants, there was considerable delay caused in obtaining the property. This was especially true of the Sparta street disposal plant, which occupied a small portion of a tract of land controlled by the Delaware, Lackawanna and Western Railroad Company. The owners refused to sell the portion required without selling the entire property, and hence it has been necessary to start condemnation proceedings. This matter has not only tied up the Sparta street plant, but made it inadvisable to start construction on the Sparta street sewer system as well.

The construction of the Clinton street purification plant is progressing nicely. The plant consists of a septic tank, dosing chamber, five sand filters and sludge bed. The five sand filters have been excavated and trimmed to grade—the gravel in three beds and the sludge bed having been placed very rapidly. It has been very gratifying to find that the sand obtainable is clean and sharp, and of a desirable size. Some trouble was feared to find good sand in sufficient quantities, but a sand bank is now being drawn from which seems to have a thoroughly ample supply of excellent quality.

The open winter has made possible much more construction than we expected this year, and we expect that the sewer systems and purification plants will all be completed and in operation by August 1st of next year.

PASSAIC RIVER.

At a meeting of the Commission held April 3d, 1905, the following resolution was unanimously adopted:

"*Resolved,* That the Attorney-General be requested to inform this Commission concerning its control of and relation to the Passaic river and the pollution thereof, in order that this Commission may take action for the remedy of the nuisance now existing."

At a meeting of the Commission held April 17th, 1905, the following communication was received from Robert H. McCarter, Attorney General:

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TRENTON, N. J., April 11, 1905.

Boyd McLean, Esq., Secretary State Sewerage Commission, 1 Montgomery street, Jersey City, N. J.:

DEAR SIR—I have before me your favor of the 7th instant, in which you state:

"I am directed by the State Sewerage Commission to inform you that the following resolution was adopted by it at its meeting held April 3, 1905:

"Resolved. That the Attorney-General be requested to inform this Commission concerning its control of and relation to the Passaic river and the pollution thereof, in order that this Commission may take action for the remedy of the nuisance now existing."

I have given such time as occasion has afforded to an examination of the matter, and beg herewith to report.

Section 5 of Chapter 72 of the laws of 1900, being an amendment to the act creating the State Sewerage Commission, provides:

"It shall be the duty of said Commission to investigate the various methods of sewage disposal, in order that it may be able to make proper recommendations in regard thereto; it shall investigate all complaints of pollution of the waters of this State which shall be brought to its notice, and if the said Commission find that any of the waters of this State are being polluted, to the injury of any of the inhabitants of this State, either in their health, comfort or property, it shall be the duty of said Commission to notify in writing any person, corporation or municipality found to be polluting said waters."

Were this law unaffected by any subsequent legislation, in my opinion your duty would be plain in regard to the present polluted condition of the Passaic river. As is well known, however, the Legislature, by chapters 48 and 49 of the laws of 1902, created the Passaic Valley Sewerage District and provided for the appointment of Commissioners, and in the tenth section provided:

"When the said Board of Commissioners are appointed and organized under this act it shall have absolute control of and supervision over the prevention of pollution throughout the said sewerage or drainage district for which the said Commissioners were appointed, exclusive of any other body or board in this State now having control of the same; *provided, however,* that nothing herein contained shall in any way affect or delay or interfere with any action or proceeding which may have heretofore been taken by the State Sewerage Commission for the purpose of preventing pollution in said sewerage district, or that may hereafter be taken by said sewerage commission for the enforcement thereof."

The Commission therein provided for has been duly appointed. The effect of the section last quoted would seem to deprive your Board of the right to act within the territory over which the Passaic Sewerage Commission has jurisdiction.

Chapter 1 of the act passed by the special session of the Legislature convened April 21, 1903, amplifies very greatly the powers of the Passaic Valley Sewerage District and authorized the construction of a sewer to relieve the district of pollution, and provided a method of assessing taxes for paying therefor. The recent decision of the Court of Errors and Appeals has upset so much of the latter act as undertakes to provide a revenue for the purposes

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of the act. I do not understand, however, that this decision goes so far as to disrupt the Commission or to overthrow the force and effect of section 10 of chapter 49 of the laws of 1902, and it would therefore seem to me to be plain that your Board has no right to act on its own initiative pursuant to the provisions of section 5 of chapter 72 of the laws of 1900, so far as territory included within the Passaic Sewerage District is concerned.

Yours very respectfully,

(Signed) ROBERT H. McCARTER,
Attorney-General.

At a meeting of the Commission held October 30th, 1905, a communication was received from the Board of Trade of the city of Newark, requesting that the members of the Commission attend a public meeting to consider remedial legislation in the matter of the Passaic river pollution, to be held at the Free Public Library Building in the city of Newark on November 14th, 1905.

On motion the Secretary was directed to notify the Board of Trade of the city of Newark that the Commission accepted its invitation to attend the meeting to be held on November 14th, 1905, and that the chairman of the Commission would be prepared to present the views of the Commission in the matter of the Passaic river pollution.

At a meeting of the Commission held November 20th, 1905, the chairman reported that the members of the Commission had attended a meeting held on November 14th, 1905, under the auspices of the Board of Trade of the city of Newark, for the purpose of considering remedial legislation in the matter of the Passaic river pollution.

PERTH AMBOY.

At a meeting of the Commission held August 28th, 1905, C. C. Hommann, City Solicitor of Perth Amboy, consulted with the Commission in regard to the proposed sewer to discharge at Sheridan street, in Perth Amboy, into the Raritan river.

At a meeting of the Commission, held September 11th, 1905, a communication was received from O. M. Cammann, Vice-President of the Chesebrough Manufacturing Company, stating that the company had no objection to the construction of the

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proposed sewer at Sheridan street, to discharge into the Raritan river, adjoining the works of the company, provided that the sewage be discharged at a sufficient depth into the river to prevent a nuisance.

The Secretary was directed to acknowledge the receipt of the communication from O. M. Cammann.

PLAINFIELD.

At a meeting of the Commission held May 15th, 1905, plans for the extension of the sewage disposal system of the city of Plainfield were received from A. J. Gavett, Street and Water Commissioner of Plainfield, and placed on file. The Secretary was directed to request Mr. Gavett to attend the next following meeting of the Commission and explain the plans submitted, and that specifications of the work be filed with the Commission.

At a meeting of the Commission held May 22d, 1905, A. J. Gavett, of the city of Plainfield, appeared before the Commission and explained the plans for the extension of the sewage disposal system of the city of Plainfield, and submitted copies of the specifications for the proposed work. He stated that the enlargement of the plant was necessary because of the increased amount of sewage received, and the extensions of the sewerage system in the city; that the plant was at present overworked, and that it would be practically doubled in size.

On motion, the plans submitted by A. J. Gavett, C.E., on behalf of the city of Plainfield, providing for the extension of the sewage disposal plant of that city, were approved by the Commission, subject to such conditions of construction, operation and purification as the Commission might from time to time require.

At a meeting of the Commission held September 25th, 1905, the Secretary reported that he had visited the Plainfield sewage disposal plant, and that the construction work on the new part of the plant was in progress.

At a meeting of the Commission held December 11th, 1905, the following report of the work at Plainfield was received from A. J. Gavett, engineer in charge:

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The work of extending the disposal works is nearly completed, the only unfinished work being one of the gate houses, finishing the roof, placing the remainder of filling material and completing the washing of stone in the old upper beds.

The extension of the works includes the duplicating of the present contact beds and new septic tanks double the size of the old ones. There will be a change in the method of distributing the septic effluent over the new contact beds and the upper beds of the old system. Instead of using pipe with open joints buried in the top foot of coarse stone, a four-inch layer of fine clinker will be placed on top of the working material and the effluent will be discharged on this layer from openings in pipes laid diagonally across the beds. The fine clinker will not cover the entire beds, but banks of two and one-half inch stone will be left to allow the free entrance of air into the beds after the fine clinker becomes coated. In other respects the new work will be similar to the old.

Included in the contract is the cleaning of the stone in the old upper beds. This is being done by the use of a Ransome concrete mixer; the stone after leaving the mixer falls on to a wire screen while water is being sprayed upon it. The contract price for this work is 60 cents per cubic yard, and the results are satisfactory. The cost of the work now under construction will be over $52,000.

RAHWAY REFORMATORY.

At a meeting of the Commission held September 25th, 1905, the Secretary was directed to inquire as to the condition of the sewage disposal plant of the State Reformatory at Rahway.

At a meeting of the Commission held October 9th, 1905, the Secretary reported that he had visited the State Reformatory at Rahway, and investigated the matter of the disposal of the sewage from that institution; that the plant, for which plans were approved by the Commission five years ago, was only partially constructed, and that it had never been completed or put in operation; that it had been standing abandoned for several years; that the crude sewage had been discharged through a ten-inch pipe laid down the Woodbridge road to the Rahway river; that the Reformatory Commission was having plans prepared for a new disposal plant, in which part of that now constructed would be utilized, and that the Commission was purchasing land to obtain a new outlet from the property of the Commission to the Rahway river, but that the Commission was unable to complete this work in the present fiscal year, and that, therefore, the appropriation

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made for it would lapse, and that the work would have to be laid over until another appropriation could be obtained.

RAHWAY RIVER.

At a meeting of the Commission held April 24th, 1905, a communication was received from James E. Warner, of Cranford, complaining of the pollution of the Rahway river by a discharge of part of the wastes of the Diamond Mills Paper Company's plant at Millburn.

At a meeting of the Commission held May 15th, 1905, the Secretary reported that he had visited the mill of the Diamond Mills Paper Company at Millburn, and had found that water had been discharged recently from the mill into the Rahway river, through a drain connecting the sewer with the river. The Secretary was directed to notify the company that complaint had been made that waste matter was discharged from its mill at Millburn into the Rahway river, and direct it to show cause at the next meeting of the Commission why it should not be required to remove the drain connecting its sewer with the Rahway river.

At a meeting of the Commission held May 22d, 1905, a communication was received from the Diamond Mills Paper Company, stating that the drainage, allowed to float from its factory into the Rahway river, was river water in its natural condition and not polluted by wastes from its mill.

RED BANK.

At a meeting of the Commission held August 28th, 1905, the Secretary reported that he had visited the sewage disposal plant at Red Bank; that the effluent contained much solid matter, and did not seem to be in a satisfactory state of purification, although these conditions might be due to the fact that the sewers were being cleaned, and an unusual amount of solid matter which had accumulated in the pipes was being discharged into the plant.

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The Secretary was directed to engage G. E. Hill, C.E., to report on the condition of the sewage disposal plant at Red Bank.

At a meeting of the Commission, held September 25th, 1905, the following report on the condition of the sewage disposal plant at Red Bank was received from G. E. Hill, C.E.:

NEW YORK, September 25, 1905.

To the Honorable the State Sewerage Commission of New Jersey:

GENTLEMEN—On Thursday, September 14th, I inspected the sewage disposal works at Red Bank. No rain had fallen since Monday, the 11th instant, and the flow through the sewers represented only domestic wastes and ground-water infiltrate.

The works, built on a site known as the "old gas-house wharf," at the foot of Bridge avenue, include:

(*a*) Two rectangular grit-chambers, each 5 x 8 and 3½ feet deep;

(*b*) One circular septic tank (the old gas-tank well) about 43 feet in diameter, with depth ranging from 9 feet 10 inches at the edge to 5 feet 9 inches at the centre, and a capacity of about 95,000 gallons;

(*c*) Two circular up-flow filters, each 12 feet in diameter, containing 21 inches of broken stone and broken brick supported on a slatted wooden false floor 2 feet above the concrete floor of the pits.

The sewage is led to the works by a 12-inch pipe, which taps the old 15-inch out-fall main in the street, passes through a manhole in the southeast corner of the disposal grounds (hereinafter called Manhole *A*) and then divides into two branches, each leading to a grit-chamber and each controlled by a gate-valve.

The two outlets leading from the grit-chambers unite in a single pipe which pierces the wall of the septic tank and ends in a down-turned elbow 11 inches below the water line of the tank. Diametrically opposite, a similar pipe, with down-turned inlet elbow, withdraws the effluent from a depth of 2 feet below the full line, separating, outside of the tank, into two branches, each controlled by a valve, which turn down again, run horizontally and end in upturned elbows in the open spaces at the bottom of the filter-pits. Two overflow pipes—one from each filter, lead to an outlet manhole, and from this a single 12-inch pipe carries the flow back to the old 15-inch outfall, which delivers it at the bottom of the river about 300 feet from shore.

Four-inch drain-pipes, controlled by valves, run from the septic tank and from each of the filters to a drainage manhole, and a 4-inch vitrified drain leads from this manhole to the river, terminating in an iron outlet just beyond the bulkhead.

As seen at Manhole *A*, the liquid was typical domestic sewage, in no way abnormal save that it was noticeably weak.

Both grit-chambers were in use. The southern (cleaned not long ago) held little or no deposit. The northern contained sludge about thirty inches deep, composed mainly of paper and fœcal matter. The soundings showed very little grit or sand.

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The water in the circular septic tank was covered with a heavy tough crust, nearly two and a half feet thick near the inlet and about eight inches thick over the outlet. Part of it had dried and crumbled into granular lumps resembling foundry coke. Very little odor arose from the mass until the crust was pierced.

Both filters were in use. The escaping effluent was a translucent gray liquid, containing very little suspended matter in particles large enough to distinguish while the stream was in motion. It had a pronounced odor of unputrefied sewage, but it was not offensive. Discharged three hundred feet from shore, at the bottom of the channel of the North Shrewsbury river, it cannot possibly cause offence or injury.

Considering the volume of flow, the filters are very small. Assuming that the voids unchoked by sludge amount to 25 per cent. of the mass of filtering material, the velocity of *dry-weather* flow through them (with both in use) is nearly a foot a minute—sufficiently rapid to carry a considerable quantity of flocculent solids. During wet weather, of course, the velocity is much increased by the entrance of storm-water.

As originally built, the filters contained six feet of filtering material; but experience proved that the flow was too fast, for clarification was far from perfect. To remedy this all the stone was removed save 21 inches. This removal of material gave the tanks additional capacity for sewage and reduced proportionally the velocity of flow *above* the broken stone. At the time of my visit the water rose from the stone to the overflow at the rate of two and two-third inches per minute—slowly enough to permit the deposition of nearly all the solids. (I drained the north filter and found the filtering material coated with a layer from one to five inches thick of fine black carbonaceous deposit.) Since the change in the depth of the broken stone the sewage is actually detained in it less than two minutes—a time entirely too short for any bacterial alteration of the impurities passing. The filters must therefore be regarded merely as mechanical strainers, save for some continued septic action in the fine sludge left in the tanks by subsidence. That septic change in this *does* occur is shown by frequent bubbling of gas through the liquid. These bubbles, in rising, carry to the surface at intervals masses of black deposit, which break and settle again as the gas escapes.

The grit-chambers are cleaned at irregular intervals, but not very often; the septic tank has never been cleaned; the filters have been emptied and cleaned twice—the second time in May, 1905.

In my opinion, the present installation is effective, so far as the treatment of the dry-weather flow is concerned. It witholds the solids and delivers, at a point where dilution is ample, an effluent fairly well clarified. All offence to the senses is obviated and the works themselves, though close to a much-traveled highway, are unobjectionable. The outflow, of course, is far from pure, and it is highly probable that infection of the sewage with unsterilized typhoid discharges would result in the transfer to the river of living germs of this specific disease. It is possible that, at such a time, serious consequences might result from bathing (and swallowing river water) or from oyster infection; but the chance is remote.

It is undoubtedly true that the plant is less efficient in wet weather than in dry, for the sewers are far from tight, the infiltration of storm and ground-

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water at times is very large, and the velocity of flow through the plant is then considerably increased. Dry-weather efficiency could be maintained at such times by the use of additional filters of suitable capacity; this capacity being determined by repeated observations and gaugings under varying conditions of weather. Before recommending any such increase in the size of the plant, however, the condition of the effluent and of the river during and after heavy rains should be investigated.

Respectfully submitted,

G. EVERETT HILL.

At a meeting of the Commission held March 20th, 1905, a communication was received from Howard Frey, of Red Bank, with plans for the disposal of sewage from a private house. The Secretary was directed to request further information.

At a meeting of the Commission held March 27th, 1905, a communication was received from Howard Frey, stating that the plans for the disposal of sewage from a private house, submitted by him, were intended for the purification of the sewage on the property of J. Wagner, Esq., at Red Bank, discharging into the Navesink river.

At the same meeting, the plans submitted by Howard Frey, of Red Bank, for the purification of the sewage from the private house of J. Wagner, Esq., at Red Bank, providing for a septic tank and two double filtering tanks, discharging into the Navesink river, were approved, subject to such conditions of construction, operation and purification as the Commission might from time to time require.

RIDGEWOOD.

At a meeting of the Commission held December 18th, 1905, the following report of the condition of the sewage disposal plant at Ridgewood was received from G. E. Hill, C.E.:

The water was turned into the flush-tanks and the sewerage system of Ridgewood was declared ready for use (though not complete in all minor details) on March 27, 1905. Since then connections have been made. The volume of sewage is considerably smaller than the estimated flow, averaging about 60 gallons per head per day instead of 100 gallons. This is due partly to unusual economy in the use of water and partly to the extremely small amount of infiltrant ground-water. Although some of the sewers are laid

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in very wet ground, the flow at the outlet, before any house connections were made, was less than half an inch deep in an 18-inch pipe.

Because the volume was less than anticipated, the sewage was detained in the septic tank too long (probably about 48 hours). The effluent during the summer was dark and unmistakably over the edge of putridity. Finding that house connections were coming in slowly, I determined to introduce spring water sufficient to bring the flow to an amount which would pass the sewage through the tank in 24 hours. The result has been entirely satisfactory. The effluent from the septic tank has lost its color and offensive odor.

While the volume of sewage was very small, the septic effluent was by-passed directly to the creek, and no water was turned into the filter beds until May 25th. Certain minor defects in the masonry walls of these beds then developed. These have interfered with the intended automatic distribution. The flow, however, has been passed through, under hand control (pending the necessary repairs), and sufficient purification has been secured to make the discharge into the Hohokus creek unobjectionable. I think that the system will be working normally in a few weeks.

VINELAND.

At a meeting of the Commission held July 17th, 1905, a report was received from R. H. Garrison, Superintendent of Public Works of the borough of Vineland, reporting that copper sulphate had been used in the purification of the sewage of the borough of Vineland, with good results; that analyses showed the destruction of the bacilli coli. The Secretary was directed to request copies of the analyses made of the effluent, showing the result of the use of copper sulphate.

At a meeting of the Commission held August 7th, 1905, copies of analyses of the effluent from the sewage disposal plant at Vineland were received from R. H. Garrison, Superintendent of Public Works of the borough of Vineland, and placed on file.

At a meeting of the Commission held August 21st, 1905, the Secretary reported that he had visited the borough of Vineland and examined its sewage disposal beds; that two of the beds were being used as settling beds before the sewage was discharged upon the beds used for filtration, the result being similar to septic tank action, a crust having formed on the sewage in the settling beds; that the beds did not seem to be kept up in proper shape, the filtering material being partially clogged and

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the effluent not being clear in appearance, and that sulphate of copper was being used, the solution being dripped into the sewage between the settling bed and the filter bed. The Secretary was directed to engage G. E. Hill, C.E., to make a report on the condition of the sewage disposal plant of the borough of Vineland.

At a meeting of the Commission held September 11th, 1905, the following report of the condition of the sewage disposal plant of the borough of Vineland was received from G. E. Hill, C.E.:

NEW YORK, September 11, 1905.

To the Honorable the State Sewerage Commission of New Jersey:

GENTLEMEN—On September 6th, in obedience to your commands, I examined the sewage disposal plant at Vineland, N. J., and its surroundings. I have also considered carefully the reports of chemical and bacteriological analyses made, respectively, by Mr. Herbert B. Baldwin and Dr. R. N. Connolly.

I found the disposal field divided into eleven beds, arranged, however, not according to the original plan filed with you.

Beds *a, b* and *c* are used, not as intermittent filters, but as settling-beds for the crude sewage. At the time of my visit *a* was not in commission, though the northern end of it contained considerable standing sewage, which leaked through from bed *b*. The rest of the surface was covered with rank grass, which a cow, tethered in the bed, was eating with apparent relish. Bed *b* contained about one foot of black sewage and sludge. Its eastern edge (about one-third of the total surface) was covered with crusted scum of a maximum thickness of about four inches. No sewage was entering this bed, but the outlet gates were open and the liquid contents were passing through gates 17 and 18, to the filters. Bed *c* contained nearly two feet of similar sewage and sludge. The entire flow was entering this bed and its outlet gates were closed. Both beds contained heavy accumulations of solids undergoing marked septic change. The appearance was very unsightly and the odor from them was offensive and strong. I was told that these settling-beds are use alternately, in pairs, in shifts of twelve hours each, one draining to the filters while another filled, the third being held in reserve; and that, at intervals of about four weeks, each bed is drained and allowed to dry, the residue being scraped off and plowed into the soil. It was evident that this process of drying and cleaning the beds must be very offensive, particularly under unfavorable conditions of wind and humidity. Judicious inquiry among neighboring residents confirmed this conclusion. The continuance through the winter of the present system of operation will be very difficult, if not impossible.

Of the eight filter-beds but seven are in use. No. 7 contained so much clay that it was abandoned some time ago. It is now covered with grass and used as a cow pasture.

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The soil of No. 8 is not much better. A sample of its surface, carefully washed, yielded only 36 per cent. of sand suitable for filtration. Small pools of water on its surface were held in depressions completely lined with clay. The filtering capacity of this bed must be very small.

Bed 6 contains much clay, but less than No. 8. Beds 2 and 4 are more porous, and bed 3 is filled with fairly good sand mixed with considerable gravel. Beds 1 and 5 were flooded to such a depth that the filtering material could not be examined.

Bed 1 was in use and flooded to a depth of about two feet. The liquid was blackish, but free from odor and scum. No. 5 (used immediately before 1) was flooded with about one foot of dark brown water, equally free from scum and odor. About two-thirds of the surface of No. 2 and four-fifths of No. 3 were covered with clear water. No. 4 was about half submerged. The water was clear, but the soil showed a little deposit of clay and organic matter. Nos. 6 and 8 were dry.

The underdrainage of the filters (as amended) is shown clearly on the accompanying diagram. Five lines of outlet enter Tarkiln creek—three of them side by side and half submerged, a fourth one in sight but completely submerged, while the fifth is so buried and overgrown that it is difficult to find. The flow from the four accessible pipes is free and strong. The fifth could not be inspected without excavation. The channel of the creek is full of water-weeds and rubbish.

Since April 20, 1905, the sewage has been treated with copper sulphate under the direction of Mr. Kellerman, Assistant Physiologist in the Laboratory of Plant Physiology, U. S. Department of Agriculture. The salt is introduced continuously after the sewage has passed the settling-bed and before it reaches the filters, but occasional doses are applied to the settling-beds themselves. At the time of my visit a small keg of copper sulphate solution was standing over gate chamber 17, and a tiny stream from its faucet was trickling into the sewage as it passed through the channel beneath. Twenty-five pounds are used per day, which gives an estimated dose of 1 part per 100,000. (At one time the quantity was reduced to fifteen pounds per day.)

The effect of this treatment upon the filter-beds is very marked. The surface is, as a rule, clean and without the usual deposit, and the flow through the beds is evidently free. I am not sure that this is altogether an advantage; for, in an untreated bed, the *schmutzdecke* (surface slime) is a valuable factor in purification.

The filtrate, as it escapes from the underdrains, is yellow-white, slightly turbid and practically odorless; but it carries continually amorphous masses of an ochraceous secondary growth—probably Crenothrix or Leptothrix. (A sample deposited its sediment rapidly, and developed no putrefactive tendencies. At the end of the third day it had no odor save a slight mustiness.) That purification is not complete is evidenced by a strong growth in the stream of Beggiattoa Alba, a characteristic sulphur-producing sewage fungus.

The chemical analysis made by Mr. Baldwin plainly confirms this judgment, although the results are somewhat indefinite because no analysis of undiluted effluent is reported. So far as mere observation makes judgment possible, the normal flow of the stream and the average flow of effluent are

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nearly equal, so that a sample taken from the stream below the junction ought to represent a mixture of about half sewage and half creek water. The relative proportions of ammonias and nitrates reported, however, indicate that the sample was taken in a current of effluent before its admixture, and that there was little or no dilution with creek water. The most favorable interpretation indicates a purification of only 70½ per cent. as measured by total ammonias (using 2.4 as the co-efficient of albumenoid ammonia) and of 78 per cent. as measured by oxygen consumed. (A peculiar feature of the effluent is the comparative absence of nitrites, although ammonias and nitrates are both high.)

Ordinarily the percentages of bacterial reduction follow very closely those of chemical purification. The effectiveness of the copper sulphate treatment is shown, therefore, by the results of Dr. Connolly's bacteriological analyses, which indicate an elmination of 97.21 per cent. of the bacteria. Check analyses, made by the bacteriologist representing the joint interests of the borough and Federal Government (operating the works as an experiment station), show a complete removal of B. coli, and, inferentially, of B. typhi. This probably means that all serious danger to Millville is eliminated before the sewage effluent leaves Vineland, even although the chemical purification be far from complete. The very considerable dilution effected by the junction of Tarkiln creek with Parvin's stream, the dissipation of these combined waters in the much greater flow of the Maurice river, and the distance traversed before the effluent units can enter the Millville water intake, are additional factors, which, in my judgment, make the safety of the existing arrangement indisputable.

It should be remembered, however, that the process of treating sewage with copper sulphate is new, and that, so far as available records are concerned, many points of importance are still undetermined. The best practice has long held that sterilization of impure water is undesirable because of the danger of secondary infection; and that the only laudable extermination of bacteria, so far at least as a water supply is concerned, is the kind that results from the reduction of pabulum below the point where sustentation of germ life is possible.

In view of this, further study should be made of the effect of copper sulphate upon the beneficient water-borne germs—particularly the nitrifying organism; upon the dissolved oxygen of streams; upon the vital functions of fish-life, including spawning and hatching; upon water-weeds and shore vegetation; upon the length of time occupied by the sewage in traversing the filters; upon effluents under stress of winter conditions, etc., etc.

As the case under discussion is one in which the U. S. Government, your own honorable body, the State Board of Health and the Borough of Vineland are all interested, it is suggested that possibly a joint investigation of these and kindred subjects may be arranged.

Although, in my judgment, the borough of Vineland is not injuring the rights of any of her neighbor communities, I feel that she owes to her own people the amelioration of some of the conditions which actually exist. The settling-beds are but a makeshift. Their use makes easier the operation of the rest of the plant; but the results are imperfect and their presence un-

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questionably offensive. I advise that these beds be abolished and a septic tank substituted therefor. Such a tank, if properly designed, will do away with the present offense to sight and smell; it will deliver an effluent better adapted for filtration; it will digest a large part of the solids now removed mechanically (particularly paper and other carbonaceous matter); it will conserve the heat of the sewage in winter and thereby facilitate the work of the filters.

The efficiency of the plant can be increased, and greater working leeway afforded, without serious expense, by removing the contents of beds Nos. 6, 7 and 8 refilling with sand of a better quality. Possibly it would be wise to refill No. 5 as well.

The grass around the beds and gate chambers should be cut and *kept cut,* encroaching weeds should be destroyed, and the channel of Tarkiln creek should be opened and cleaned.

Respectfully submitted,

(Signed) G. EVERETT HILL.

At the same meeting the Secretary was directed to forward a copy of the report made by G. E. Hill, C.E., on the Vineland sewage disposal plant to the authorities of the borough of Vineland, and to notify them to show cause at the next following meeting of the Commission why they should not be required to adopt the recommendations contained in the said report, that a septic tank be built, that some of the disposal beds be refilled with a better grade of sand, that the grass around the beds be cut and kept cut and the weeds destroyed, and that the channel of Tarkiln creek be opened and cleaned.

At a meeting of the Commission held September 18th, 1905, Herbert C. Bartlett, Borough Solicitor; A. L. Hanford, Borough Councilman; and R. H. Garrison, Superintendent of Public Works of the borough of Vineland, appeared before the Commission in response to a notice to show cause why the Commission should not require the adoption by the borough of the recommendations made for the improvement of the sewage disposal plant of the borough.

Mr. R. H. Garrison stated that the borough was prepared to adopt the recommendations made by the Commission, that the filtering material of the beds be removed and a good quality sand used to refill the beds; that the banks of the beds be regraded and the grass growing thereon be kept trimmed, and that the bed of Tarklin creek be cleaned and kept clean. He further

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stated that the recommendation that a septic tank be built met with the approval of the borough authorities, but that they found it impossible to raise funds for this work at the present time. He also stated that the use of the settling beds was feasible during the winter months, they having been used during the past winter without interruption, and that the Department of Agriculture wished to conduct some experiments in relation to the use of settling beds, which would be impossible if the septic tank were substituted for the beds at this time. For these reasons, he requested that action be deferred in regard to the question of a septic tank.

Mr. H. C. Bartlett stated that the borough of Vineland had been put to very large expense in connection with its electric light, water and sewerage plants, and that it had issued bonds up to the amount authorized by law; that it could raise money to meet the expense of improving the sewerage beds, but could not at the present time raise funds for the construction of a septic tank; that the reports of the examinations of the beds showed that they were doing excellent work, and that the borough authorities requested him to ask that action be postponed on the question of installing a septic tank until such time as the borough could meet the expense.

Mr. A. L. Hanford stated that he lived but a short distance from the sewerage beds and had noticed no nuisance because of them; that there were very few complaints made by anybody in the neighborhood of the beds of any nuisance, and that he thought there would be no local objection to allowing a continued use of the settling beds until money could be raised by the borough for the construction of a septic tank.

On motion the Commission adopted the following resolution:

Resolved, That the borough of Vineland be required, as soon as practicable, to remove the filtering material in its sewage disposal beds; to replace the same with good clean sand; to regrade the banks of the beds and keep the same covered with a strong-rooted grass, to be kept trimmed short; to remove all weeds from the beds; and to open and keep clean the bed of Tarkiln creek in the vicinity of the sewerage beds; and that the borough be permitted temporarily to use beds not underdrained as settling beds, before the sewage is discharged on the beds used for filtering purposes, until such time as other requirements shall be made by this Commission.

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WOODSTOWN.

At a meeting of the Commission held February 27th, 1905, a complaint was received from Mrs. A. L. Dickeson of the pollution of a brook running through her property at Woodstown in Salem county. The Secretary was directed to request further information.

At a meeting of the Commission held March 20th, 1905, a communication was received from Mrs. A. L. Dickeson, giving details of the pollution of Salem creek at Woodstown. The Secretary was directed to investigate the complaint.

At the same meeting, a communication requesting advice as to sewage disposal was received from E. P. McGeorge, M.D., of Woodstown, and the Secretary was directed to communicate with him.

At a meeting of the Commission held March 27th, 1905, the Secretary reported that he had visited Woodstown to investigate the complaint of the pollution of Salem creek; that he found that a branch of Salem creek in Woodstown was being polluted by the direct discharge of crude sewage from four or five private sewers; that he had consulted with a committee of citizens who proposed the construction of a sewerage system by a private company, and that the action proposed by them would prevent the nuisance created by the present pollution of the branch of Salem creek.

At a meeting of the Commission held June 5th, 1905, a communication in relation to the pollution of Salem creek was received from Mrs. Dickeson, and a communication in relation to the same matter was received from C. Flitcraft. The Secretary was directed to inquire what progress was being made in the matter of the organization of the proposed sewer company at Woodstown.

At a meeting of the Commission held June 19th, 1905, communications were received from E. P. McGeorge, M.D., and Mrs. Dickeson in relation to the proposed sewers for Woodstown, and filed.

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At a meeting of the Commission held August 21st, 1905, a report was received by the Commission that a franchise for the proposed sewerage company had been adopted by the borough council, but that no action had been taken by the proposed company in regard to the acceptance of the franchise.

The Secretary was directed to notify all persons in Woodstown, who were polluting Salem creek, to show cause why they should not be ordered to cease such pollution, and to make such disposal of their polluting matter as the Commission should direct, at a meeting of the Commission to be held September 11th, 1905.

At a meeting of the Commission held September 11th, 1905, communications were received in relation to the matter of the pollution of Salem Creek at Woodstown from the following parties: E. S. Fogg, Solicitor for the Mayor and Council of the borough of Woodstown, First National Bank of Woodstown, Mrs. James Sharp, William C. Flitcraft and the Hanes heirs; William C. Gebhardt, Solicitor for Joseph H. Reading; William T. Hilliard, Trustee of the Estate of Omar Borton, deceased; William D. Clayton, Borough Councilman; Mrs. A. L. Dickeson; Charles F. Pancoast; F. J. Collier; E. E. DeGrofft, M.D.; Wilbert Richman and Wallace S. Roberts. These communications informed the Commission that an ordinance had been passed by the borough council on August 28th, 1905, giving the Woodstown Sewer Company the right to acquire the sewers already laid in the borough, with a view to adding extensions and properly caring for the outlet; that this ordinance had been accepted by the company, and that active measures would be taken to avoid further pollution of Salem creek.

At a meeting of the Commission held September 18th, 1905, a communication from E. S. Fogg, Borough Solicitor of Woodstown, stating that active measures were being taken in relation to the adoption of plans for the disposal of the sewage of Woodstown, and requesting that action in regard to the pollution of Salem creek be deferred, was received and filed.

At a meeting of the Commission held September 25th, 1905, a communication was received from Charles F. Pancoast, Secretary of the Woodstown Sewer Company, stating that a site for a

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disposal plant had been selected on Salem creek, and asking whether that met with the approval of the Commission. The Secretary was directed to request more definite information of the proposed location of the sewage disposal plant and the method of disposal.

At a meeting of the Commission held October 9th, 1905, the Secretary reported that he had visited Woodstown, for the purpose of consulting with the Woodstown Sewer Company; that plans had not yet been prepared; that he had recommended the immediate employment of a sanitary engineer for the purpose of preparing plans, so that the work could be finished before winter, if possible; and that he had also inspected the proposed place of discharge of the sewage.

A communication from Clark Flitcraft, President of the Woodstown Sewer Company, stating that plans for a sewage disposal plant would be submitted to the Commission as soon as possible, was received and filed.

At a meeting of the Commission, held November 27th, 1905, a communication from C. F. Pancoast, Secretary of the Woodstown Sewer Company, reporting that plans for a sewerage system for Woodstown were being prepared and would soon be forwarded for the approval of the Commission, was received and filed.

OTHER WORK OF THE COMMISSION.

The Commission has had a series of chemical and bacteriological examinations made during the year, showing the results of the purification plants under its jurisdiction. The bacteriological examinations were made by Richard N. Connolly, M.D., of Newark, and a complete report of his work has been received by the Commission, and is annexed hereto. The chemical examinations were made by Herbert B. Baldwin, chemist, of Newark, and a complete report of his work is also annexed hereto.

The Commission has made some investigation in the matter of shellfish pollution. It engaged George W. Fuller, consulting engineer, of New York, to prepare a report on this subject, to show the present state of knowledge concerning it, and the

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practical matters to be considered. This report has been submitted to the Commission and is annexed hereto.

In the act creating the Commission, provision was made for the collection of the sewerage statistics of the various municipalities. This was done in 1899, and the results included in the first report of this Commission. After a lapse of six years this has again been done during the past fall. Owing to slowness of municipal authorities, these statistics are not yet complete, but so far as they have been obtained they are given in a special report hereto annexed. They indicate considerable progress in some cases in sewerage matters, and, also, in other cases, lack of progress.

Respectfully submitted,

BOYD McLEAN,

Secretary.

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Bacteriologist's Report.

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Bacteriologist's Report.

To the Honorable the State Sewerage Commission of New Jersey:

GENTLEMEN—Herewith is respectfully submitted the report of the bacteriological examinations of samples of sewage from various disposal plants, obtained under instructions received from the Commission.

The plants from which samples were examined represent a wide variety of methods of sewage disposal, and the requirements to be met at each place vary with the locality.

At some of the places it is only required that the effluent be of such a character as not to be offensive to sight or smell.

At others the final effluent is required to be of a high degree of purity, as it is discharged into streams, the water from which is used for drinking purposes below the point of discharge.

Because of this wide variety of conditions it is difficult to adopt a general standard that would apply to all plants, and it is necessary to treat each plant as a unit, to study the requirements of the locality and determine the conditions under which each plant is capable of doing its best work, or how it may be improved in an economical manner.

This work the Commission has been doing for a number of years, and the part assigned to me this year was to test the general efficiency of the plants by making bacteriological examinations of the sewage before, during and after treatment.

This investigation has been carried on along the lines usually adopted for such work, modified in only one detail, but a detail which seems very important to me, and one that has been used in the Newark Board of Health Laboratory for several years in the routine water examinations with very good results.

The modification consists of taking advantage of the power of intestinal bacteria to produce fermentation in culture media

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containing glucose. For this purpose a series of fermentation tubes is inoculated with the material under examination by which we determine the minimum amount that will cause fermentation.

The tube that contains the smallest amount of the sample in which fermentation is produced is selected and sub-cultures made from its contents to determine if the gas is caused by the Colon Bacillus.

A brief description of our methods may be of value for future comparison.

The samples were collected in sterilized glass stoppered two-ounce bottles, each bottle being protected by a tin can that had also been sterilized, and the same care was taken in collecting the samples as though the fluid was to be used for drinking purposes.

We endeavored to limit the time between taking the samples and plating them out at the laboratory to within six hours, arranging our trips so as to get back to the laboratory in the shortest possible time.

This was done to minimize the development of bacteria in the samples while contained in the collecting bottles.

When the samples reached the laboratory two agar plates and two gelatine plates were made from each and a series of fermentation tubes inoculated.

The agar plates were grown at room temperature, the gelatine plates at 13° to 15° C., and the fermentation tubes were incubated at 37° C.

The colonies on the agar plates were counted after three days, those on the gelatine plates after four days and the averages obtained were taken as the number of bacteria per cubic centimeter in the original fluid.

The gas production in the fermentation tubes was observed after thirty-six hours.

The fermentation tubes consist of glass tubing bent "U" shaped, one limb being closed to retain the gas produced by bacterial growth. These tubes contained five cubic centimeters of glucose bouillon, and into each was carefully measured a definite amount of the sample. The first tube of a series received one-half a cubic centimeter of the suspected fluid, and each succeeding

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tube was inoculated with a smaller quantity than the one preceding it, until the amount was reduced by dilution to one-millionth of a cubic centimeter in the last.

After incubation the character and amount of the gas produced was observed, and from the tube that contained the least amount of sewage which produced the characteristic fermentation sub-cultures were made by streaking the surface of Loëffler blood serum.

These secondary cultures were incubated at 37° C. for twenty-four hours, after which time it is usually comparatively easy to obtain isolated colonies of colon bacilli if any were present in the original material.

The pure cultures obtained from the Loëffler medium were then examined and their identity established by observing their gas producing power in glucose bouillon, inability to liquify gelatine and the production of acid.

The fermentation test, when carried out in this manner, enables us to determine to what extent the coli communis is present in a sample of crude sewage and permits us to compare results with those obtained from any other sample treated in the same manner and under the same conditions.

By this means we may gauge to what degree intestinal bacteria persist in the sewage after it has passed through a disposal plant, or has been exposed to any other plan of treatment.

It must be borne in mind that fermentation tests alone are not conclusive evidence that intestinal bacteria are present in a given sample, but with preliminary cultivation in fermentation tubes and subsequent sub-cultures for identification, we have a far more delicate test for this class of bacteria than is afforded by plating out the original fluid and searching for them among the colonies of water and soil bacteria with which sewage is usually highly charged.

Many of the latter bacteria are eliminated by the high temperature at which the fermentation and sub-culture tubes are developed.

It will frequently be found that the sub-cultures on Löffler blood serum will contain but two or three varieties of bacteria,

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making it comparatively simple to pick out isolated colonies and test them.

Regarding the presence of a large number of bacteria in the effluent from a sewage disposal plant, some authorities are disposed to claim that it is wise to have them present, as they continue the work of reducing organic matter begun in the plant, after the effluent has been discharged.

This may be sound reasoning and permissible under some conditions, but it seems to me that we should aim to have as much of the bacterial reduction take place within the plant as we possibly can, and not be constantly trying to economize and reduce expenses by discharging partially reduced sewage—rich in organic and putrescible matter, trusting to bacteria to complete the work under conditions over which we have no control.

During the past five months thirteen different plants have been visited and fourteen series of samples were collected for examination.

These plants were visited in company with Mr. H. B. Baldwin, who collected corresponding samples for chemical analysis, the results of which will be found in his report.

The results of the bacteriological examinations, together with the percentage of bacterial reduction, so far as could be determined from the limited number of examinations for each plant, are given in the following tables.

These tables contain the date and time at which the samples were taken, the origin of each sample, the number of bacteria per cubic centimetre and the amount of the sample producing gas in the fermentation tubes, together with a marginal note of the smallest quantity of the sample from which the colon bacillus was isolated.

SEWAGE DISPOSAL PLANT AT VINELAND, N. J.

This plant consists of a series of sand filter beds which are under drained. Two beds without underdrains were being used as settling beds.

The effluent is discharged into a small creek that empties into the Maurice river, from which water for drinking purposes is taken at Millville, N. J.

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Copper sulphate was being used in the sewage at the time the samples were taken, and it was difficult to determine to what extent it influenced the results.

The bacterial reduction between the crude sewage and final effluent in this series was about 97 per cent.

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BACTERIOLOGICAL EXAMINATION OF SAMPLES OF SEWAGE AND WATER FROM VINELAND, N. J.

Date.	Time.	ORIGIN OF SAMPLE.	APPEARANCE.	Bacteria Per C. C.	Amount of Sample Causing Fermentation in 5 C. C. Glucose Bouillon.								
					1/2 C. C.	1/5 C. C.	1/10 C. C.	1/20 C. C.	1/100 C. C.	1/1,000 C. C.	1/10,000 C. C.	1/100,000 C. C.	1/1,000,000 C. C.
1905 Aug. 16	11:40 A.M.,	Crude sewage before entering settling beds,....	Turbid, ...	2,767,000	+	+	+	+	+	+	+	+	+
Aug. 16	1:50 A.M.,	Crude sewage before entering settling beds,....	Turbid, ...	1,696,000	+	+	+	+	+	+	+	+	—
Aug. 16	11:50 A.M.,	Effluent from filter beds at Tarkiln creek,.....	Slightly turbid. Yellow ppt.,.....	77,000	+	+	+	+	+	+	+	—	—
Aug. 16	12:00 M.,	Effluent from Tarkiln creek, about 125 feet below outlet from filter beds, ...	Slightly turbid. Fl. ppt., ...	60,000	+	+	+	+	+	+	—	—	—
Aug. 16	1:45 P.M.,	Effluent from Tarkiln creek, about 125 feet below outlet from filter beds, ...	Slightly turbid. Fl. ppt., ...	52,000	+	+	+	+	+	+	—	—	—
Aug. 16	12:10 P.M.,	Water from Tarkiln creek, about 500 feet above outlet from filter beds, ...	Clear with purple tinge, ...	27,000	+	+	+	+	—	—	—	—	—
Aug. 16	1:30 P.M.,	Water from Tarkiln creek, about 500 feet above outlet from filter beds, ...	Clear with purple tinge, ...	48,000	+	+	+	+	—	—	—	—	—
Aug. 16	2:45 P.M.,	Water from Tarkiln creek after junction with Parvin's stream, at Sherman avenue bridge,	Clear with slight yellow ppt., ...	120	+	+	+	+	+	—	—	—	—
Aug. 16	2:30 P.M.,	Water from Maurice river, at raceway near Millville, N. J., ...	Clear. Slight yellowish green ppt.,.....	25	+	+	—	—	—	—	—	—	—

B. Coli found in 1/1,000,000 C.C.	
B. Coli found in 1/100,000 C.C.	
B. Coli found in 1/10,000 C.C.	
B. Coli found in 1/1,000 C.C.	
B. Coli found in 1/1,000 C.C.	
B. Coli found in 1/20 C.C.	
B. Coli found in 1/20 C.C.	
B. Coli found in 1/100 C.C.	
B. Coli. Not typical.	

Samples arrived at laboratory August 16th, 1905, at 8 P. M.

The sign (+) means fermentation produced.
The sign (—) means no fermentation produced.

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SEWAGE DISPOSAL PLANT AT RED BANK, N. J.

This plant consists of a septic tank and two filters, the effluent from which is discharged into tide water.

The results obtained by examination of two series of samples from this plant indicate that there is little or no reduction in the bacteria by the treatment the sewage receives.

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BACTERIOLOGICAL EXAMINATION OF SEWAGE AND EFFLUENT FROM RED BANK, N. J.					Amount of Sample Causing Fermentation in 5 C.C. Glucose Bouillon.									
Date.	Time.	ORIGIN OF SAMPLE.	APPEARANCE.	Bacteria Per C.C.	1/2 C.C.	1/5 C.C.	1/10 C.C.	1/20 C.C.	1/100 C.C.	1/1,000 C.C.	1/10,000 C.C.	1/100,000 C.C.	1/1,000,000 C.C.	
1st Series														
1905 Aug. 23	5:30 P.M.,	Crude sewage, ...	Turbid, ...	260,000	+	+	+	+	+	+	+	+	—	B. Coli found in 1/100,000 C.C.
Aug. 23	5:40 P.M.,	Effluent, ...	Turbid, ...	245,000	+	+	+	+	+	+	+	+	—	B. Coli found in 1/100,000 C.C.
2d Series														
Sept. 14	2:45 P.M.,	Crude sewage, ...	Turbid, ...	177,000	+	+	+	+	+	+	—	—	—	B. Coli found in 1/1,000 C.C.
Sept. 14	2:20 P.M.,	Effluent from septic tank, ...	Turbid, ...	345,000	+	+	+	+	+	+	—	—	—	B. Coli found in 1/1,000 C.C.
Sept. 14	2:35 P.M.,	Effluent from filter beds, ...	Turbid, ...	285,000	+	+	+	+	+	+	—	—	—	B. Coli found in 1/1,000 C.C.

(1st Series.) Samples reached laboratory at 7:15 P. M.
(2d Series.) Samples reached laboratory at 6:15 P. M.

The sign (+) means fermentation produced.
The sign (—) means no fermentation produced.

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BACTERIOLOGICAL EXAMINATION OF SEWAGE FROM PLAINFIELD, N. J.					Amount of Sample Causing Fermentation in 5 C. C. Glucose Bouillon.									
Date.	Time.	ORIGIN OF SAMPLE.	APPEARANCE.	Bacteria Per C. C.	1/2 C. C.	1/5 C. C.	1/10 C. C.	1/20 C. C.	1/100 C. C.	1/1,000 C. C.	1/10,000 C. C.	1/100,000 C. C.	1/1,000,000 C. C.	
1905														
Sept. 19	10:30 A.M.,	Crude sewage from manhole at entrance to septic tank,	Turbid,	6,540,000	+	+	+	+	+	+	+	+	+	B. Coli found in 1/1,000,000 C.C.
Sept. 19	11:55 A.M.,	Crude sewage from manhole at entrance to septic tank,	Turbid,	5,960,000	+	+	+	+	+	+	+	+	+	B. Coli found in 1/1,000,000 C.C.
Sept. 19	10:40 A.M.,	Combined effluent from both septic tanks,	Turbid,	2,530,000	+	+	+	+	+	+	+	+	+	**B. Coli found in 1/1,000,000 C.C.**
Sept. 19	12:00 M.,	Combined effluent from both septic tanks,	Turbid,	3,770,000	+	+	+	+	+	+	+	+	+	**B. Coli found in 1/1,000,000 C.C.**
Sept. 19	10:50 A.M.,	Effluent from first contact bed—continuous flow (straining bed),	Turbid,	3,340,000	+	+	+	+	+	+	+	+	—	B. Coli found in 1/100,000 C.C.
Sept. 19	12:00 M.,	Effluent from first contact bed—continuous flow (straining bed),	Turbid,	2,750,000	+	+	+	+	+	+	+	+	—	B. Coli found in 1/100,000 C.C.
Sept. 19	10:55 A.M.,	Final effluent at discharge into Green brook (after two hours in second contact bed),	Slightly turbid,	360,000	+	+	+	+	+	+	+	+	—	B. Coli found in 1/100,000 C.C.
Sept. 19	12:05 P.M.,	Final effluent at discharge into Green brook (after two hours in second contact bed),	Slightly turbid,	356,000	+	+	+	+	+	+	+	+	—	B. Coli found in 1/100,000 C.C.

Samples reached laboratory at 2:30 P. M.

The sign (+) means fermentation produced.
The sign (—) means no fermentation produced.

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SEWAGE DISPOSAL PLANT AT PLAINFIELD, N. J.

This plant consists of a septic tank with primary and secondary contact beds.

Extensive alterations were being made when the samples were obtained, so that while the septic tank was apparently doing good work, the subsequent treatment of the sewage in the contact beds was interfered with to some extent.

The results, therefore, were not so good as may be expected when the improvements are completed.

The series of samples examined would indicate a bacterial reduction of about 94 per cent. The presence of the colon bacillus, however, in one hundred-thousandth of a C.C. of the effluent, would suggest that this percentage is more apparent than real.

Owing to difficulties in operation due to the construction work going on, the primary bed was being used as a filter with continuous flow at the time the samples were taken.

SEWAGE DISPOSAL PLANT AT MOORESTOWN, N. J.

This plant consists of a grit chamber, a septic tank and contact beds.

The examination of this series of samples would indicate a bacterial reduction of about 84 per cent., and the fermentation tests showed a marked decrease in the colon bacilli.

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BACTERIOLOGICAL EXAMINATION OF SEWAGE FROM MOORESTOWN, N. J.					Amount of Sample Causing Fermentation in 5 C.C. Glucose Bouillon.								
Date.	Time.	ORIGIN OF SAMPLE.	APPEARANCE.	Bacteria Per C.C.	1/2 C.C.	1/5 C.C.	1/10 C.C.	1/20 C.C.	1/100 C.C.	1/1,000 C.C.	1/10,000 C.C.	1/100,000 C.C.	1/1,000,000 C.C.	
1905 Oct. 3	4:20 P.M.,	Crude sewage, ...	Turbid, ...	1,484,000	+	+	+	+	+	+	+	+	+	B. Coli found in 1/1,000,000 C.C.
Oct. 3	4:30 P.M.,	Effluent from septic tank, ...	Turbid, ...	580,000	+	+	+	+	+	+	+	+	—	B. Coli found in 1/100,000 C.C.
Oct. 3	4:40 P.M.,	Final effluent from contact beds, ...	Slightly turbid, ...	243,000	+	+	+	+	+	+	+	—	—	B. Coli found in 1/10,000 C.C.

Samples reached laboratory at 9 P. M.

The sign (+) means fermentation produced.
The sign (—) means no fermentation produced.

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SEWAGE DISPOSAL PLANT AT COLLINGSWOOD, N. J.

This plant consists of a septic tank, from which the sewage is pumped onto coke contact beds and these discharge over wave beds.

It was impossible to obtain a sample of the final effluent in a satisfactory manner, as after passing over the wave beds the effluent mixes with tide water, which backs up from the creek into which the beds empty; therefore, the extent of purification at this plant could not be determined.

The figures obtained failed to indicate any material change in the sewage, even after septic tank and coke contact bed treatment. The sewage was pumped irregularly, the pumping taking place in a short period of time each day. The beds were clogged and a considerable part of the sewage passed over the surface of each of the beds. Lack of care was evident in every part of the plant. These facts would account for the condition of the sewage after treatment.

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BACTERIOLOGICAL EXAMINATION OF SEWAGE FROM COLLINGSWOOD, N. J.

Date.	Time.	ORIGIN OF SAMPLE.	APPEARANCE.	Bacteria Per C.C.	Amount of Sample Causing Fermentation in 5 C.C. Glucose Bouillon.									
					1/2 C.C.	1/5 C.C.	1/10 C.C.	1/20 C.C.	1/100 C.C.	1/1,000 C.C.	1/10,000 C.C.	1/100,000 C.C.	1/1,000,000 C.C.	
1905 Oct. 6	1:15 P.M.,	Crude sewage from manhole near septic tank,..	Turbid, ...	1,749,000	+	+	+	+	+	+	+	+	—	B. Coli found in 1/100,000 C.C.
Oct. 6	1:30 P.M.,	Effluent from septic tank at coke bed,.....	Slightly turbid, ...	1,260,000	+	+	+	+	+	+	+	+	—	B. Coli found in 1/100,000 C.C.
Oct. 6	1:35 P.M.,	Effluent from coke contact beds at flush tank near wave beds, ...	Slightly turbid, ...	1,550,000	+	+	+	+	+	+	+	+	—	B. Coli found in 1/100,000 C.C.

Samples reached laboratory at 7:30 P. M.

The sign (+) means fermentation produced.
The sign (—) means no fermentation produced.

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SEWAGE DISPOSAL PLANT AT HADDONFIELD, N. J.

This plant consists of a grit chamber, a septic tank and a series of sand filter beds.

The bacterial count of this series would indicate a reduction of about 97 per cent., and the fermentation tests show a corresponding reduction in the colon bacilli.

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BACTERIOLOGICAL EXAMINATION OF SEWAGE FROM HADDONFIELD, N. J.

Date.	Time.	ORIGIN OF SAMPLE.	APPEARANCE.	Bacteria Per C. C.	Amount of Sample Causing Fermentation in 5 C. C. Glucose Bouillon.									
					1/2 C. C.	1/5 C. C.	1/10 C. C.	1/20 C. C.	1/100 C. C.	1/1,000 C. C.	1/10,000 C. C.	1/100,000 C. C.	1/1,000,000 C. C.	
1905 Oct. 6	2:45 P.M.,	Crude sewage from gate chamber near septic tanks, ...	Turbid, ...	2,226,000	+	+	+	+	+	+	+	+	+	B. Coli found in 1/1,000,000 C.C.
Oct. 6	2:55 P.M.,	Effluent from septic tanks at outlet gate,.....	Turbid, ...	1,431,000	+	+	+	+	+	+	+	+	—	B. Coli found in 1/100,000 C.C.
Oct. 6	3:05 P.M.,	Final effluent from sand filter beds, ...	Yellowish and slightly turbid, ...	68,000	+	+	+	+	+	+	—	—	—	B. Coli found in 1/1,000 C.C.

Samples reached laboratory at 7:30 P. M.

The sign (+) means fermentation produced.
The sign (—) means no fermentation produced.

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SEWAGE DISPOSAL PLANT AT BURLINGTON, N. J.

This plant consists of a receiving chamber or pump well, a septic tank, broken stone contact beds and sand filter beds. This combination, if properly maintained, gives, to my mind, the most satisfactory results of any system of sewage disposal.

The results indicate this if we compare the bacterial count of the crude sewage with the effluent from filter bed No. 1, which gives us a reduction of about 96 per cent., with a corresponding reduction in the colon bacilli, judging from the fermentation tests.

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BACTERIOLOGICAL EXAMINATION OF SEWAGE FROM BURLINGTON, N. J.

Date.	Time.	ORIGIN OF SAMPLE.	APPEARANCE.	Bacteria Per C. C.	Amount of Sample Causing Fermentation in 5 C. C. Glucose Bouillon.									
					1/2 C. C.	1/5 C. C.	1/10 C. C.	1/20 C. C.	1/100 C. C.	1/1,000 C. C.	1/10,000 C. C.	1/100,000 C. C.	1/1,000,000 C. C.	
1905 Oct. 13	11:40 A.M.,	Raw sewage from tank near pumping station,..	Turbid, ...	2,346,000	+	+	+	+	+	+	+	+	+	B. Coli found in 1/1,000,000 C.C.
Oct. 13	11:50 A.M.,	Effluent from septic tank, ...	Turbid, ...	3,170,000	+	+	+	+	+	+	+	+	+	B. Coli found in 1/1,000,000 C.C.
Oct. 13	12:10 P.M.,	Final effluent (from contact and filter beds at discharge drain from Bed No. 1),.....	Clear. Slight ppt.,..	97,000	+	+	+	+	+	+	+	—	—	B. Coli found in 1/10,000 C.C.
Oct. 13	12:20 P.M.,	Final effluent (from contact and filter beds at discharge drain from Bed No. 2),.....	Clear. Slight ppt.,..	130,000	+	+	+	+	+	+	+	+	—	B. Coli found in 1/100,000 C.C.

Samples reached laboratory at 7:30 P. M.

The sign (+) means fermentation produced.
The sign (—) means no fermentation produced.

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SEWAGE DISPOSAL PLANT AT WESTFIELD, N. J.

This plant consists of a distributing chamber, a series of sand filter beds, which are under drained, and what might be called auxiliary filter beds through which the primary beds drain into a creek.

When we visited this plant we found it badly handicapped by storm water from rain that had fallen the day before. Only one filter bed was in operation, and the effluent from this at the point where it enters the creek showed a bacterial reduction of but 18 per cent., and fermentation tests showed no change between the crude sewage and final effluent.

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BACTERIOLOGICAL EXAMINATION OF SEWAGE FROM WESTFIELD, N. J.

Date.	Time.	ORIGIN OF SAMPLE.	APPEARANCE.	Bacteria Per C. C.	Amount of Sample Causing Fermentation in 5 C. C. Glucose Bouillon.									
					1/2 C. C.	1/5 C. C.	1/10 C. C.	1/20 C. C.	1/100 C. C.	1/1,000 C. C.	1/10,000 C. C.	1/100,000 C. C.	1/1,000,000 C. C.	
1905 Oct. 21	11:50 A.M.,	Crude sewage from screening tank, ...	Turbid, ...	87,000	+	+	+	+	+	+	+	+	—	B. Coli found in 1/100,000 C.C.
Oct. 21	12:20 P.M.,	Effluent from Filter Bed No. 4, at discharge into creek, ...	Turbid, ...	72,000	+	+	+	+	+	+	+	+	—	B. Coli found in 1/100,000 C.C.

Samples reached laboratory at 4:30 P. M.

The sign (+) means fermentation produced.
The sign (—) means no fermentation produced.

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SEWAGE DISPOSAL PLANT AT NEW LISBON, BURLINGTON, CO., N. J.

This plant consists of a screening chamber, a septic tank and a slag contact bed.

In the short distance through which the sewage flows between the disposal plant and the institution there is not time for much breaking up of the solid matter in the fluid; consequently, the sample of crude sewage examined did not properly represent the actual condition, and it would be more nearly accurate in this case to estimate the purification percentage by using the figures for the septic tank effluent and that from the contact bed.

These would indicate a reduction of about 85 per cent.

The laundry wastes from the insane asylum, at which the plant is located do not pass through the disposal plant, but run through an old sewer to a catch basin from which a sample was taken. The presence of coli bacilli in the laundry wastes from an insane asylum is easily understood, but the large number present in this instance may indicate a leak at the point of connection between the old sewer and the new disposal system.

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BACTERIOLOGICAL EXAMINATION OF SEWAGE FROM COUNTY INSANE ASYLUM, NEW LISBON, BURLINGTON COUNTY, N. J.

Date.	Time.	ORIGIN OF SAMPLE.	APPEARANCE.	Bacteria Per C.C.	Amount of Sample Causing Fermentation in 5 C.C. Glucose Bouillon.									
					1/2 C.C.	1/5 C.C.	1/10 C.C.	1/20 C.C.	1/100 C.C.	1/1,000 C.C.	1/10,000 C.C.	1/100,000 C.C.	1/1,000,000 C.C.	
1905 Oct. 24	2:10 P.M.,	Crude sewage from screening tank, ...	Slightly turbid, ...	950,000	+	+	+	+	+	+	+	+	—	B. Coli found in 1/100,000 C.C.
Oct. 24	2:15 P.M.,	Effluent from septic tank, ...	Slightly turbid, ...	1,260,000	+	+	+	+	+	+	+	+	—	B. Coli found in 1/100,000 C.C.
Oct. 24	2:30 P.M.,	Final effluent from contact bed at manhole,....	Clear. Fl. ppt.,.....	197,000	+	+	+	+	+	+	+	—	—	B. Celi found in 1/10,000 C.C.
Oct. 24	2:45 P.M.,	Laundry waste from catch basin,.....	Turbid, ...	2,170,000	+	+	+	+	+	+	+	—	—	B. Coli found in 1/10,000 C.C.

Samples reached laboratory at 7:30 P. M.

The sign (+) means fermentation produced.
The sign (—) means no fermentation produced.

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SEWAGE DISPOSAL PLANT AT COUNTY INSANE ASYLUM, OVERBROOK, N. J.

This plant consists of a screening chamber, a septic tank and sand filter beds (primary and secondary).

At this plant the distance between the institution and the disposal plant is so short that little or no decomposition of the solid matter in the sewage can take place, and the fluid does not represent the actual condition; consequently, percentages based on the crude sewage and final effluent examination here have little value.

The final effluent, however, contained a greater number of bacteria and the colon bacilli were more numerous than we should expect from such a plant. Some alterations had recently been made and it is very probable that the filter beds had not reached their maximum capacity of purification when the tests were made.

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BACTERIOLOGICAL EXAMINATION OF SEWAGE FROM OVERBROOK, N. J.

Date.	Time.	ORIGIN OF SAMPLE.	APPEARANCE.	Bacteria Per C. C.	Amount of Sample Causing Fermentation in 5 C. C. Glucose Bouillon.									
					1/2 C. C.	1/5 C. C.	1/10 C. C.	1/20 C. C.	1/100 C. C.	1/1,000 C. C.	1/10,000 C. C.	1/100,000 C. C.	1/1,000,000 C. C.	
1905 Nov. 3	1:40 P.M.,	Crude sewage from chamber at entrance to septic tank,	Turbid,	530,000	+	+	+	+	+	+	+	—	—	B. Coli found in 1/10,000 C.C.
Nov. 3	1:45 P.M.,	Effluent from septic tank,	Turbid,	760,000	+	+	+	+	+	+	+	+	+	B. Coli found in 1/1,000,000 C.C.
Nov. 3	1:55 P.M.,	Effluent from first filter bed,	Slightly turbid,	370,000	+	+	+	+	+	+	+	+	—	B. Coli found in 1/100,000 C.C.
Nov. 3	2:00 P.M.,	Final effluent from second filter bed at discharge into drain,	Clear,	193,000	+	+	+	+	+	+	+	+	—	B. Coli found in 1/100,000 C.C.

Samples reached laboratory at 4 P. M.

The sign (+) means fermentation produced.
The sign (—) means no fermentation produced.

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SEWAGE DISPOSAL PLANT AT LAKEHURST, N. J.

This plant consists of a grit or screening chamber, a septic tank and two sand filter beds.

The plant is chiefly maintained for the sewage from a large winter hotel, and at the time of our visit the season was about beginning and comparatively few guests had arrived; consequently, only a small amount of sewage was being discharged.

The distance from the hotel to the septic tank is about 600 feet, and, as we have found at other places similarly situated, the fluid of the crude sewage does not represent the character of the material with which the plant has to deal. The effluent from the septic tank compared with the final effluent indicated a reduction of about 97 per cent.

The final effluent contained, despite this high reduction, 111,000 bacteria per C.C., and colon bacilli were very numerous, making the effluent an undesirable, if not a dangerous, addition to a stream.

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BACTERIOLOGICAL EXAMINATION OF SEWAGE FROM LAKEHURST, N. J.

Date.	Time.	ORIGIN OF SAMPLE.	APPEARANCE.	Bacteria Per C.C.	Amount of Sample Causing Fermentation in 5 C.C. Glucose Bouillon.									
					1/2 C.C.	1/5 C.C.	1/10 C.C.	1/20 C.C.	1/100 C.C.	1/1,000 C.C.	1/10,000 C.C.	1/100,000 C.C.	1/1,000,000 C.C.	
1905 Nov. 9	1:45 P.M.,	Crude sewage from entrance to septic tank,....	Turbid, ...	670,000	+	+	+	+	+	+	+	+	+	B. Coli found in 1/1,000,000 C.C.
Nov. 9	1:55 P.M.,	Effluent from septic tank—manhole on Orchard street, ...	Slightly turbid, ...	3,430,000	+	+	+	+	+	+	+	+	+	B. Coli found in 1/1,000,000 C.C.
Nov. 9	11:55 A.M.,	Final effluent from filter beds at discharge into creek, ...	Clear, ...	111,000	+	+	+	+	+	+	+	+	—	B. Coli found in 1/100,000 C.C.

Samples reached laboratory at 5:45 P. M.

The sign (+) means fermentation produced.
The sign (—) means no fermentation produced.

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SEWAGE DISPOSAL PLANT AT RIDGEWOOD, N. J.

This plant consists of a septic tank, a series of broken stone contact beds and a series of wave beds. The plant is new, and some defects in concrete work had developed, which were being repaired when the samples were taken. The beds from which samples were taken had been out of use for some time and then placed in operation again. They had not been working for a sufficient length of time to produce their best results. If this plant is maintained in its present condition, it will probably show a higher degree of purification than the effluent at this examination indicates, when it has been longer in use.

The bacterial reduction between the crude sewage and final effluent was about 80 per cent.

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BACTERIOLOGICAL EXAMINATION OF SEWAGE FROM RIDGEWOOD, N. J.

Date.	Time.	ORIGIN OF SAMPLE.	APPEARANCE.	Bacteria Per C. C.	Amount of Sample Causing Fermentation in 5 C. C. Glucose Bouillon.									
					1/2 C. C.	1/5 C. C.	1/10 C. C.	1/20 C. C.	1/100 C. C.	1/1,000 C. C.	1/10,000 C. C.	1/100,000 C. C.	1/1,000,000 C. C.	
1905 Dec. 6	1:00 P.M.,	Crude sewage from manhole at entrance to septic tank,	Turbid,	760,000	+	+	+	+	+	+	+	+	+	B. Coli found in 1/1,000,000 C.C.
Dec. 6	1:25 P.M.,	Effluent from septic tank at primary contact bed,	Turbid,	490,000	+	+	+	+	+	+	+	—	—	B. Coli found in 1/10,000 C.C.
Dec. 6	1:35 P.M.,	Effluent from primary contact bed,	Turbid,	320,000	+	+	+	+	+	+	+	+	—	B. Coli found in 1/100,000 C.C.
Dec. 6	1:45 P.M.,	Final effluent from wave beds at pump-house,	Slightly turbid,	157,000	+	+	+	+	+	+	+	+	—	B. Coli found in 1/100,000 C.C.

Samples reached laboratory at 4 P. M.

The sign (+) means fermentation produced.
The sign (—) means no fermentation produced.

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SEWAGE DISPOSAL PLANT AT ASYLA, CAMDEN CO., N. J.

This plant consists of a grit-chamber, a septic tank and primary and secondary contact beds. The distance from the institutions to the disposal plant is very short, and, as was found at other places so situated, the fluid sewage is not representative.

The distributing apparatus on the beds was not in working order, and all of the beds were not in use, only part of the surface area being flooded. Channels had been worn through the filtering material, allowing rapid passage of the sewage.

The septic tank effluent compared with the final effluent at this plant showed a bacterial reduction of about 70 per cent. in the beds.

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BACTERIOLOGICAL EXAMINATION OF SEWAGE FROM ASYLA, CAMDEN COUNTY, N. J.

Date.	Time.	ORIGIN OF SAMPLE.	APPEARANCE.	Bacteria Per C. C.	Amount of Sample Causing Fermentation in 5 C. C. Glucose Bouillon.									
					1/2 C. C.	1/5 C. C.	1/10 C. C.	1/20 C. C.	1/100 C. C.	1/1,000 C. C.	1/10,000 C. C.	1/100,000 C. C.	1/1,000,000 C. C.	
1905														
Dec. 13	1:20 P.M.,	Crude sewage from grit chamber at septic tank,	Turbid, ...	530,000	+	+	+	+	+	+	+	—	—	B. Coli found in 1/10,000 C.C.
Dec. 13	1:30 P.M.,	Effluent from septic tank, ...	Turbid, ...	780,000	+	+	+	+	+	+	+	+	—	B. Coli found in 1/100,000 C.C.
Dec. 13	1:40 P.M.,	Effluent from first contact bed, ...	Slightly turbid, ...	366,000	+	+	+	+	+	+	+	+	—	B. Coli found in 1/100,000 C.C.
Dec. 13	1:45 P.M.,	Final effluent from second contact bed,.....	Slightly turbid, ...	240,000	+	+	+	+	+	+	+	—	—	B. Coli found in 1/10,000 C.C.

Samples reached laboratory at 7 P. M,

The sign (+) means fermentation produced.
The sign (—) means no fermentation produced.

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The above examinations are of value mainly as showing the character of the effluent from each plant at the time the samples were taken, and until a number of duplicate tests have been made it is wise to withhold judgment based entirely on these determinations.

The character of the crude sewage is a very varying quantity, changing from hour to hour, depending on household wastes, and from day to day influenced by dry or wet, cold or warm weather.

These factors make it necessary to obtain data extending over considerable time before a final conclusion can be reached regarding the efficiency of any disposal system.

By inspecting most of the plants from which samples have been examined it is evident that the constructing engineer carefully worked out the local problems to be met with and constructed his plant to the best of his ability with the material at hand. After the engineer completed his work it was turned over to the care of indifferent or insufficient management, under whose care it is usually expected not only to run itself, but in most cases repair itself, and old age soon sets in.

It seems such false economy for a community to spend thousands of dollars constructing a plant, and often before it has reached its period of greatest usefulness allow it to be neglected and become an offensive if not a dangerous adjunct.

Provision should be made for the constructing engineer or some one equally competent to have a personal supervision over the plant and instruct those in actual charge how to operate it to get the best results.

Similar observations have been made many times before in different parts of the world, so that neglect of disposal plants is the rule, and only constant agitation will finally induce those whose duty it is to provide for the proper maintenance of such plants to appreciate the necessity for constant care and intelligent supervision.

Yours respectfully,

RICHARD N. CONNOLLY, M.D.

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Chemist's Report.

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Chemist's Report.

The Honorable State Sewerage Commission of New Jersey:

GENTLEMEN—I herewith submit a report of the chemical examinations of the sewage and effluent from the various disposal plants in this State from which samples were collected by me for analysis during the past few months, under your direction. These samples were taken at the same time and from the same places as those upon which bacteriological tests were made by Dr. R. N. Connolly. As requested by you, I include herewith a brief explanation of the tests made.

Sewage is a waste liquid containing a certain amount of suspended and dissolved organic and inorganic matters. The former containing nitrogen and carbon compounds, which in decomposing give rise to odors and produce ammonia, which goes into solution and is estimated as free ammonia. Something less than one-half of the nitrogenous organic matter in the sewage can be decomposed in the laboratory and converted into ammonia and is called albumenoid ammonia. The nitrites are the results of the oxidation of the free ammonia and represent the temporary transition stage of the nitrogen between its existence in free ammonia and in the form of nitrates, which represents the limit of oxidation and purification. The dissolved oxygen present in an effluent is acquired through its contact with air and indicates the probability of further purification through oxidation to nitrates of the nitrogenous matter. The per cent. of saturation expresses the relative amount of dissolved oxygen present, 100 representing the highest possible amount which could be present at the observed temperature. The oxygen consumed is the amount of oxygen required to oxidize carbonaceous matter during five minutes' boiling with permanganate of potassium. Chlorine exists principally as common salt, and although a characteristic ingredient

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of sewage, is not changed or eliminated through purification, and neither is it objectionable. The total solids is the residue left after evaporating the sewage to dryness, but a part of the organic matter is lost in the process. The loss on ignition represents the loss on burning the total solids at a red heat, and is mostly organic matter. The fixed mineral matter is the ash left on burning the total solid residue and is the difference between the figure for total solids and loss on ignition. The alkalinity represents the temporary hardness equivalent to carbonate of lime.

The system of purification in each place, whether by septic tank, contact filter or sand filter, is indicated in the table of analytical results. Included in the table are figures showing the percentage of purification based on the removal of the albumenoid ammonia and the oxygen consumed, the former referring to organic nitrogen and the latter to organic carbon. In the absence of direct data for total organic nitrogen it was thought that this method would best represent the comparative effectiveness of the purification although it is fully realized that the percentages given are not more than approximate, as the samples as taken, especially the raw sewage, were subject to wide variation in composition. This variation occurs more particularly in the sewage from small places and institutions from which a sudden discharge of a large volume of wash water might make the raw sewage better than some of the effluents.

In comparing results one of the most noticeable features is the difference between town and institution sewage. The latter has a higher temperature, considerable dissolved oxygen and an extremely variable composition. These conditions are due to the very uneven use of water and the comparatively short distance of flow to the disposal plant, during which much of the solid matter does not have time to become disintegrated and go into solution nor the dissolved oxygen to be utilized in the oxidation of organic matter. So variable is sewage of this character that it was found impracticable to compute percentages of purification in some cases.

Besides the variation in institutional sewage above noted there are some anomalous data found in the analyses of the town sewage. These have satisfactory explanations, but a specific

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example may be found in the considerable amount of dissolved oxygen in the septic tank effluent from the Ridgewood system. This may be accounted for by the flow of about 2,000 feet, through a pipe partly filled with air, before it reaches the contact beds where the sample was taken.

It is obvious that entirely definite conclusions cannot be reached from a single series of analyses, but the averages obtained compare well with those in other places with similar systems. The average purification for the septic tank effluents, omitting Red Bank and all institutional sewage except Overbrook, is 50 per cent. for albumenoid ammonia and 41 per cent. for oxygen consumed and for the final effluents 82 per cent. and 75 per cent. respectively.

The above figures do not very widely differ from those obtained in each plant except in the case of Collingswood, where backed up tidewater partly submerges the wave beds and seriously interferes with their proper working.

The Red Bank results were not included in the average because the plant was not designed to and does not effect a purification comparable with the other systems. At the time the samples were taken for the first examination of the sewage at Red Bank the sewers a short distance above the disposal plant were being cleaned. On this account an unusual amount of solid matter which had become deposited in the pipe was being discharged into the disposal plant. As this condition would affect the results obtained a second examination was made.

The examination made at Vineland is intended to indicate the amount of pollution in Tarkiln creek, Parvin's branch and the Maurice river, due to the Vineland sewage disposal system rather than to show the absolute work of the plant. Examinations were made to show the condition of Tarkiln creek both before and after the effluent was discharged into it. Another sample was taken from Parvin's branch, about three miles below after Tarkiln creek discharges into the branch. These examinations show some pollution of Tarkiln creek above the disposal beds which is much increased by the effluent from the beds, but the examination made three miles below the beds indicates that

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an extremely small amount of pollution reaches the Maurice river.

At the time the samples were taken at Plainfield construction work on the enlargement of the plant was being carried on, and this interferred to some extent with the normal working of the beds. One of the contact beds was used as a continuous filter. This probably affected to some degree the purification accomplished.

The plant at Moorestown, consisting of septic tank and four contact filters, was so operated at the time of taking samples that each contact bed had three days' rest and was used for one day. Although the effluent from this plant was in a very satisfactory condition, it is probable that an increased percentage of purification could be obtained by using the beds with a shorter period of rest.

At Collingswood samples were taken of the crude sewage, the effluent from the septic tank and the effluent from the primary contact beds. No samples could be obtained from the secondary wave beds because they were partially submerged by tide water from Newton creek, the sluice gate being out of repair. The septic tank is apparently accomplishing some degree of purification, although this is difficult to understand in view of the irregularity with which the sewage is pumped from the tank. The irregular pumping makes such changes in the level of the septic tank as to make it impossible for a proper scum to form on the tank. This is interfering with septic action. The effluent from the primary contact bed shows a slightly worse condition than the effluent from the septic tank. This can probably be attributed to variations in the flow of sewage. Practically there is no difference between the effluent from the septic tank and the effluent from the primary beds because the beds are used continuously instead of being used as contact beds, and are so channeled and guttered that some of the sewage passed directly through in as short a time as five minutes without time or opportunity for any change.

This is equally true of the secondary wave beds, although the sewage mixes so quickly with creek water that no analysis was practicable. The sewage practically ran over the surface of

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the wave beds without passing through the filtering material, the voids being clogged with scum and grease.

At Haddonfield when the samples were taken all five of the sand filter beds were flooded. The purification by filtration was satisfactory, but it was too slow. This condition is probably owing to clogging of the under drains and of the surface of the filter beds.

At Burlington the plant at the time the samples were taken was in a rather unkempt condition, but the effluent from the sand filters showed a good degree of purification.

At Westfield the samples were taken under unusual conditions owing to recent storm, and part of the sewage was escaping without purification. The part of the sewage going through the plant showed good results, but this can hardly be taken as indicating the ordinary work of the plant without further investigation.

At the Ridgewood plant the purification effected as indicated by the analyses is for albumenoid ammonia 57 per cent., 75 per cent. and 76 per cent., respectively, for the septic tank effluent, the primary bed effluent and the secondary bed effluent. For oxygen consumed the figures for the same samples are 60 per cent., 75 per cent. and 76 per cent. It is an unusual coincidence that these figures should be so nearly alike. There is practically but little difference between the effluent from the primary contact bed and the final effiuent. This may be because the works had been recently constructed, and contact beds do not do very efficient work until they have been in operation a considerable time.

At Overbrook the institutional sewage conforms more nearly to ordinary city sewage than in other institutional cases. At this plant the septic tank is doing good work, but the filter beds seem to be overloaded and are not accomplishing results that might otherwise be obtained.

At Lakehurst a fair degree of purification is obtained. At Asyla it is impossible to judge the work of the septic tank. The filter beds were accomplishing a very slight degree of purification. The distributing apparatus was out of order and the sewage passed too rapidly through the beds.

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	PARTS PER MILLION.															Per Cent. of Purification	
1905	Temp. F °		Free Ammonia.	Albumenoid Ammonia.	Chlorine.	Nitrogen as Nitrites.	Nitrogen as Nitrates.	Alkalinity.	Oxygen Consumed in 5 minutes at 100° C.	Oxygen Dissolved.	Per Cent. of Saturation.	Total Solids.	Loss on Ignition.	Fixed Residue.	Albumenoid Ammonia Removed.	Oxygen Consumed. Removed.
	Sewage.	Air.														
Vineland— Aug. 15																
Raw sewage,	.....	.....	13.8	4.67	49.	None	None	89	27.00	.....	.....	262	132	130	.....	.....
Tarkiln creek,	.....	.....	.024	.115	18.5	.05	3.60	37	2.25	.....	.....	118	18	100	.....	.....
Tarkiln creek + effluent,	.....	.....	6.00	.57	43.	.20	12.50	37	5.90	.....	.....	209	67	142	.....	.....
Parvin's branch, 3 miles below,	.....	.....	.010	.014	2.8	None	.18	7	.75	.....	.....	21	3	18	.....	.....
Red Bank— Aug. 23																
Raw sewage,	60	88	8.5	4.1	71	None	None	128	27.40	.5	7	450	206	244	.....	.....
Final effluent,	.....	.....	12.5	3.68	68	None	None	142	24.80	None	.....	392	170	222	10	9.5
Red Bank— Sept. 14																
Raw sewage,	59	57	17.9	2.90	59	None	None	130	25.20	.....	.....	310	128	182	.....	.....
Final effluent,	.....	.....	13.9	2.14	89	None	None	130	22.80	.....	.....	368	104	264	26	9.5
Septic tank effluent,	.....	.....	15.1	3.00	83	None	None	123	23.00	.....	.....	345	100	245	.....	.....
Same after passing filter,	.....	.....	13.8	2.24	82	None	None	125	22.40	.....	.....	321	90	231	.....	.....
Plainfield— Sept. 19																
Raw sewage,	64	78	32.4	9.30	102	None	None	270	49.40	None	.....	690	340	350	.....	.....
Effluent from septic tank,	65	.....	12.63	2.62	50	None	None	203	26.00	None	.....	368	158	210	71	47
Effluent from 1st contact bed,	66	.....	20.50	2.06	47	None	None	200	20.40	None	.....	342	120	222	78	59
Effluent from 2d contact bed,	.....	.....	9.72	.90	44	.02	None	143	9.20	7.25	74	259	62	197	90	81
Moorestown— Oct. 3																
Raw sewage,	60	66	10.82	2.13	25	None	None	90	16.00	.....	.....	225	92	133	.....	.....
Septic tank effluent,	61	.....	11.00	1.15	26	.20	None	84	13.20	1.17	16	172	60	112	46	18
Final effluent,	62	.....	8.40	.78	32	.04	.40	84	4.80	4.33	44	169	50	119	63	70
Collingswood— Oct. 6																
Raw sewage,	63	64	25.50	5.50	36	None	None	121	2.54	.....	.....	299	179	120	.....	.....
Effluent from septic tank,	.....	.....	19.70	3.20	33	None	None	110	1.80	None	.....	216	103	113	42	29
Effluent from 1st filter,	.....	.....	20.20	3.58	33	None	None	100	1.54	None	.....	145	67	78	35	39
Haddonfield— Oct. 6																
Raw sewage,	63	64	23.60	5.45	44	None	None	400	36.0	.....	.....	822	270	552	.....	.....
Effluent from septic tank,	62	.....	27.40	3.54	60	None	None	165	27.6	None	.....	304	105	199	35	23
Effluent from sand filter,	67	.....	22.04	.95	76	None	None	134	8.2	.25	2	250	50	200	82	77

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1905	Temp. F° Sewage.	Temp. F° Air.	Free Ammonia.	Albumenoid Ammonia.	Chlorine.	Nitrogen as Nitrites.	Nitrogen as Nitrates.	Alkalinity.	Oxygen Consumed in 5 minutes at 100° C.	Oxygen Dissolved.	Per Cent. of Saturation.	Total Solids.	Loss on Ignition.	Fixed Residue.	Per Cent. of Purification: Albumenoid Ammonia Removed.	Per Cent. of Purification: Oxygen Consumed. Removed.
			PARTS PER MILLION.													
Burlington—	Oct. 13															
Raw sewage,	62	56	13.80	4.34	42	.20	None	136	36.00	.....	.....	435	200	235	.....	.....
Effluent from septic tank,	62	.....	13.50	2.72	65	.08	None	135	26.40	.33	3	355	130	225	37	26
Effluent from sand filters,	60	.....	8.68	.36	70	.076	3.00	92	9.60	4.67	42	302	62	240	91	73
Westfield—	Oct. 21															
Raw sewage,	59	54	10.82	3.60	28	.145	None	155	31.80	.....	.....	326	150	176	.....	.....
Effluent from sand filter,	57	.....	5.12	.44	26	.020	.45	106	7.20	3.83	36	189	47	142	88	77
Ridgewood—	Dec. 6															
Raw sewage,	.....	41	23.40	9.60	110	None	None	170	78.00	.....	.....	2014	1700	314	.....	.....
Effluent from septic tank,	46	.....	23.00	4.10	92	None	None	210	30.60	.5	4	445	150	295	57	60
Effluent from 1st contact bed,	40	.....	23.10	2.34	92	Trace	None	210	19.60	None	.....	365	110	255	75	75
Effluent from 2d contact bed,	41	.....	22.70	2.30	91	Trace	None	200	19.00	2.00	13	380	100	280	76	76
New Lisbon—	Oct. 24															
Raw sewage,	71	62	.70	1.70	10	None	None	10	13.30	6.00	63	175	75	100	.....	.....
Effluent from septic tank,	71	.....	4.00	1.50	10	None	None	21	14.20	3.50	40	100	53	47	.....	.....
Effluent from slag filter,	68	.....	4.50	.90	10	.040	Trace	40	9.20	1.66	18	90	32	58	.....	.....
Overbrook—	Nov. 3															
Raw sewage,	68	50	3.14	5.80	17	.050	None	100	34.40	4.75	52	262	140	122	.....	.....
Effluent from septic tank,	65	.....	12.00	3.00	17	.020	None	100	21.60	None	.....	191	100	91	48	34
Effluent from 1st sand filter,	60	.....	11.80	2.40	16	.150	None	100	20.40	None	.....	182	70	112	58	47
Effluent from 2d sand filter,	51	.....	9.10	1.00	15	.180	.20	80	11.00	1.41	13	160	40	120	82	68
Lakehurst—	Nov. 9															
Raw sewage,	58	45	6.00	2.40	15	None	None	62	47.00	2.25	22	255	178	77	.....	.....
Effluent from septic tank,	55	.....	39.55	3.85	45	.008	None	160	41.00	None	.....	332	170	162	.....	.....
Effluent from sand filter,	50	.....	15.50	1.55	45	.160	2.00	100	17.00	2.67	24	175	55	120	.....	.....
Asyla—	Dec. 13															
Raw sewage,	60	48	5.30	1.90	12	.010	None	112	19.00	3.91	22	206	95	111	.....	.....
Effluent from septic tank,	58	.....	19.80	2.10	20	None	None	182	19.40	None	.....	255	95	160	.....	.....
Effluent from 1st filter bed,	56	.....	20.30	1.60	20	None	None	182	13.00	1.67	16	250	70	180	.....	.....
Effluent from 2d filter bed,	55	.....	20.10	1.40	20	.020	Trace	176	11.60	3.59	34	130	50	80	.....	.....

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Perhaps the most striking observation made when visiting plants and collecting samples was, except in a very few instances, the lack of knowledge on the part of those in charge as to the theory of sewage purification and the principles involved in the construction of their works, and, consequently, the failure to operate the system to the best advantage. In no case did this condition appear to be the result of unwillingness to learn, but rather was due to the fact that after the constructive engineer had finished his work the management devolved on those who were not skilled in engineering matters, and who in some cases transferred the position to others with even less experience.

Another observation was that although many of the plants have so-called contact beds, they were really used as such in only two of the places visited.

For convenience of comparison I have prepared the results of the analyses made by me in the form of a table, which is annexed to this report.

Very respectfully,

HERBERT B. BALDWIN.

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Report on Shellfish Pollution.

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Shellfish Pollution.

To the Honorable the State Sewerage Commission of New Jersey:

GENTLEMEN—In response to your request I have prepared the following statement of the present evidence upon shellfish pollution. It is essentially a digest of many hundreds of pages of testimony and scientific literature from various sources, prepared for convenient reference by those having to consider this subject. At the close of the paper is a summary of the principal features, together with some references to New Jersey conditions and their requirements as to treatment.

Oyster scares during the past dozen years have been of sufficiently frequent occurrence to produce considerable agitation in the mind of the public. They have resulted in such a feeling of uncertainty that it has affected somewhat the shellfish industry, causing the dealers who handle shellfish from sources above suspicion to suffer from the faults of their competitors. In brief, the marketing of shellfish in some places from sewage polluted waters has produced a condition of affairs which needs correction in a practical way, both from the standpoint of the public health and of the shellfish industry.

New Jersey is one of the largest shellfish producing States. According to recent statistics its annual output of oysters approximates 3,600,000 bushels, having a total estimated value of about $2,250,000. This represents over 15 per cent. of the value of the total oyster production of this country. Its output of clams is annually about 625,000 bushels, valued at $608,000, or about 35 per cent. of that of the total output of clams in this country.

Within the past year or two information has become more definite regarding the real facts of shellfish pollution, both as to

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its cause and effect. This is especially true in Great Britain, where elaborate reports of inquiry into the subject have been issued by the Royal Commission on Sewage Disposal and by the Local Government Board of Ireland. The subject has also been studied with care in several places in this country, particularly in Massachusetts, where active steps already have been taken to prevent the marketing of shellfish from grossly polluted sources.

It is the endeavor here to record clearly the evidence* as to transmission of disease by shellfish, to show briefly how sewage causes infection, and to point out some of the means of correction being considered elsewhere.

EARLY INSTANCES OF DISEASE TRANSMISSION THROUGH INFECTED OYSTERS.

Even prior to the establishment some twenty-five years ago of the germ theory of disease, numerous cases were cited of the well-established relationship between typhoid fever, cholera and similar intestinal diseases and the eating of oysters and other shellfish taken from sources polluted with human excreta.

The first instance on record was cited by Dr. Pasquier in 1816. This French physician wrote a book entitled "The Oyster from the Medical Point of View," and in it described an instance where a workman laid down 60,000 oysters in a fattening bed excavated in the moat of an old citadel into which the sewage of the garrison had been discharged for centuries. These oysters were consumed for the first time on September 10th, 1816, and on the 20th and 21st of the same month, after the lapse of the necessary period of incubation for typhoid fever germs, cases of that disease made their appearance among the consumers.

In 1820 the British medical journals record an outbreak of gastro-enteritis at Dunkirk, which was reported to have been due to oysters procured on the coast of Normandy.

During the cholera epidemic in Great Britain in 1849 an out-

* Much of this evidence in a somewhat more technical form, with an extensive bibliography, appears in a paper by the writer in the Journal of the Franklin Institute, August, 1905.

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break of this disease occurred at Bridgewater and Taunton, which was considered to have been due to the consumption of some apparently decomposing oysters which had been condemned as unfit for food, but which were, nevertheless, given to school children in the district. This outbreak was officially examined by Dr. Britton, of the General Board of Health, and was referred to a little later in medical literature by Sir D. W. Richardson.

In 1876, on the Isle of Man, there occurred an epidemic of typhoid fever which was alleged to have been due to the consumption of oysters.

The earliest reference in more recent medical literature to this subject occurs in a paper read before the British Medical Association in 1880 by Sir Charles Cameron, Health Officer of Dublin, Ireland. His proposition that oysters obtained from polluted sources might cause typhoid fever was so novel that the chairman of the meeting inquired if his paper were intended as a joke. In 1889 it appears from the investigations of this gentleman that cases of typhoid fever in Dublin were recorded as possibly having had their origin from oysters which had been laid down in the sewage-polluted Dublin bay.

Prof. de Giaxa, of Pisa, made a study of the bacterial flora of the bay of Naples, and in his paper in 1889 recorded some observations on the longevity of the disease germs in salt water, and referred then and later to the question of infection by shellfish.

Following the epidemic of cholera in Hamburg late in 1892 there appeared some scattered cases of cholera in England, which were considered to have been directly caused in part by the consumption of oysters from Cleethorpes and Grimsby, according to Sir R. Thorne Thorne, medical health officer of the local government board, and Dr. Reece, inspector.

RECENT OUTBREAKS OF TYPHOID FEVER DUE TO INFECTED OYSTERS AND OTHER SHELLFISH.

The epidemic of typhoid fever associated with polluted shellfish which has attracted most widespread attention was that at Wesleyan University, at Middletown, Connecticut. As stated in the admirable report of Prof. Conn, there were seven fra-

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ternity banquets on October 12th, 1894, at Middletown, which were attended by about 100 students, some of whom were guests from other universities. Following the ordinary period of incubation of typhoid fever, twenty-three cases of this disease appeared among the local students and six cases among the guests who had attended three of these banquets. By a most exhaustive inquiry there were eliminated other foods which might possibly have conveyed typhoid fever germs, including water, ice, milk, ice cream, uncooked vegetables, etc. By eliminating these articles of food and drink and by comparing the portions of the menu eaten by those who did and those who did not sicken of typhoid fever, and, further, by comparing the diet before and after the banquet of the various students and guests, there was left no room for doubt about the uncooked oysters being the source of infection. Additional weight was given to this conclusion by the appearance of typhoid fever among six of the guests who had eaten oysters at these banquets, but who had not been exposed to any local factors other than at the banquet, and by the further fact that no typhoid fever appeared among students attending on the same evening the other four banquets at which oysters were served, either from other sources or cooked.

Investigation showed that the oysters in question had been obtained from Fairhaven, Conn. They had been taken from deep water in Long Island Sound and brought into the mouth of the Quinnipiac river and allowed to lie in brackish water for a day or two for fattening. Close to the fattening beds were the outlets of a number of private sewers, one of which, 300 feet distant from the bed, drained a house in which were two cases of typhoid fever. Each link in the chain of evidence was established beyond all reasonable doubt.

It was the Middletown epidemic which first drew the attention of the public in a prominent way to the relation between shellfish and diseases. Since that time many instances have occurred of somewhat similar nature.

Among those which were investigated most carefully by competent official sanitarians may be mentioned the mayoralty banquets, in 1902, at Winchester and Southampton, England. In this instance there were two banquets, held on the same evening

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in distant cities, at which oysters from the same polluted source were served uncooked. At each banquet a considerable portion of the guests were shortly seized with gastro-enteritis, and others were later attacked with typhoid fever. Of 267 guests 118 suffered from the former and 21 from the latter disease.

Instances of such outbreaks are a matter of record in nearly all countries where oysters or other shellfish are eaten in an uncooked condition. It is needless here to recite them all in detail, the particulars of which can be largely ascertained in Dr. Bulstrode's testimony before the Royal Commission and his classical paper on "Oyster Culture in Relation to Disease," issued by the Local Government Board of England in 1896. As a matter of convenient record, however, reference may be made here to a few of the more important ones, as follows:

Truro, England.—A supper party of seven in this city was reported to have eaten oysters from a source known to be polluted. All of them were taken ill, some with typhoid fever and some with gastro-enteritis. The medical officer of health of the city, Dr. Sharp, reported in 1897 that the infected oysters were the cause.

St. Andre de Sangonis, France.—Dr. Chantemesse read a paper on this subject before the Paris Academy of Medicine. He drew attention to fourteen persons from six families having eaten raw oysters taken from the sewage-polluted canal at Cette. All of these persons were made ill, some with typhoid fever and some with gastro-enteritis, while no illness whatever appeared among the members of these families who ate no oysters.

Dr. Mosny, who wrote an excellent series of articles five years ago on "Mollusk Poisoning" in France, refers to a more recent instance in a village near Paris, where gastro-enteritis followed the eating of oysters from Cette.

Other instances of oyster pollution are reported from Monte Carlo, Naples, Florence, Milan, Constantinople and New Zealand. Numerous physicians could doubtless recite cases of shellfish infection within their observation, typical instances of which were recorded by Sir William Broadbent in 1895.

Clams, mussels and other shellfish have been found to transmit disease, but as they are not so generally in use as oysters (at

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least in America), the well-known cases are not so numerous as with the oysters.

Patrons of summer resorts, especially at the seashore, doubtless suffer more from infected shellfish, as a general proposition, than is believed by many. To trace clearly the significance of such factors in a floating population is obviously difficult. It is of interest, however, to mention the recent instances at Atlantic City and at Lawrence, L. I.

Atlantic City, N. J.—This well-known seashore resort, although provided with a public water supply of satisfactory quality, and with a milk supply found upon careful examination to have been safe, has at times suffered from an undue prevalence of typhoid fever, especially during the summer of 1902. The cause of this typhoid fever was found to be largely due to oysters freshened in sewage-polluted waters, and clams taken from similar waters, according to an investigation made by the Atlantic City Academy of Medicine. This conclusion was concurred in by Prof. A. C. Abbott and Prof. Henry Leffman, of Philadelphia. Since the taking of shellfish from polluted sources has been prohibited by the local board of health there has been no abnormal prevalence of typhoid fever at this resort, according to Dr. Guion, the health officer.

Lawrence, L. I.—This small summer resort on the Rockaway peninsula on the south shore of Long Island suffered during the summer and autumn of 1904 from a sporadic outbreak of typhoid fever, the total number of cases being 31. According to the careful investigations of Dr. Soper, more than two-thirds of these cases were traced directly or indirectly to shellfish taken from the adjoining coves of Jamaica bay, the water of which is polluted with local sewage.

RELATION OF POLLUTED SHELLFISH TO THE GENERAL PREVALENCE OF TYPHOID FEVER.

A moment's reflection will show that the most serious aspect of oyster pollution does not relate by any means to outbreaks at large banquets or summer hotels, but rather to the significance

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which this proposition bears to the various cases of this disease scattered throughout the entire world of shellfish-eating people. It is well known that typhoid fever frequently appears among people who, so far as can be ascertained, have not been exposed to infected water, milk or other foods. These occurrences constitute what are generally called sporadic or isolated cases of typhoid fever.

To ascertain even in a general way the relation of various shellfish to these isolated cases is a very difficult and complicated matter. In the recent inquiry conducted in a most careful manner into this general proposition by the Royal Commission of Great Britain on the disposal of sewage, a circular letter requesting information upon this subject to thirty-one county councils drew forth the fact that twenty-one of them had no evidence bearing upon the question. The principal information elicited by these letters from the remainder may be briefly summarized as follows:

Southend-On-Sea, England.—The health officer, Dr. Nash, expressed his opinion, as the result of careful investigation, that at least fifty per cent. of the local typhoid fever cases were due to the consumption of shellfish from sources contaminated by sewage.

Yarmouth, England.—Dr. Nash also quoted typhoid fever statistics from Yarmouth, where this disease had prevailed to a high degree for several years prior to 1900, when the sale of mussels from the River Yare was stopped. In 1901 the typhoid fever records showed only about 30 per cent. of the previous average, and in 1902 there was still further reduction.

Brighton, England.—During the years 1894 to 1902 the health officer, Dr. Newsholme, investigated each case of typhoid fever in Brighton and found that out of a total of 643 cases 158 were directly ascribable to the consumption of oysters and eighty other cases to the consumption of other shellfish within the period of incubation. These shellfish in each instance were taken from layings proven to be exposed to sewage pollution. In the opinion of Dr. Newsholme, 37 per cent. of all typhoid fever cases is an under estimate of the effect upon that community of polluted shellfish.

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Manchester, England.—During the years 1897 to 1902, inclusive, 2,664 cases of typhoid fever occurred, and according to the health officer, Dr. Niven, 118 of these were strictly ascribable to oysters and mussels, and 156 more were associated with the consumption of other shellfish. In round numbers, therefore, in the city of Manchester about 10 per cent. of the typhoid fever during this period seems to have been due to polluted shellfish.

London, England.—According to Health Officer Murphy, of the Metropolitan District of London, more than 8 per cent. of all the cases of typhoid fever in that district during 1902 were indicated by consistent evidence to have been caused by polluted shellfish.

In America the evidence obtained as to the relation between typhoid and shellfish has not been exhaustively studied, although it has received considerable attention in New York city and in some other places. There are no adequate data on which to base any comparisons with the experiences in the English cities above cited. When the much-needed data upon this question are available it will probably be found that the wider use of shellfish in America than in Europe will be a factor; although, of course, the net result depends upon the number of infected oysters reaching a given population.

CONCERNING THE LIFE HISTORY OF THE OYSTER.

It is not the intention in this paper to enter into a detailed technical description of the anatomy or physiology of the oyster. It is desired, however, to refer somewhat briefly to those well-known features of its mode of living which bear a relation to possible opportunities for the oyster to become polluted in waters containing sewage or other undesirable drainage.

Larval Oysters.—Like all other mollusks, the oyster reproduces exclusively by eggs. Each spatting oyster is estimated to give rise to more than 1,000,000 ova in a single season. From the eggs there are hatched small free-swimming larvæ, which swim about for a short time until the shell appears. They drift about with the tide, current or wind, and are carried frequently far away from their native bed. A large proportion of them, how-

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ever, never reach maturity. Not only are the larvæ destroyed by cold and by living enemies in the water, but many of them perish by becoming deposited in muddy places where survival is impossible. After the larvæ pass through the free-swimming stage, those which develop further become fixed upon some hard, clean substance.

Oyster Spats.—When the shell of the infant oyster becomes large enough to cause deposition it is commonly called, at this stage of development, the "Oyster spat." It has the appearance of a white glistening speck, not unlike a spot of candlegrease. The spatting season varies in different localities, but ordinarily occurs within the period from May to September, inclusive. The oyster farmer gives careful attention to the "fall of spat," and in many instances artificial collectors are provided, upon which they may become deposited. These frequently consist of clean, empty oyster shells, branches of trees, tiles, etc. In the natural beds the spats become attached to rocks or reefs; if they do not reach some solid support, they obviously sink in the mud and become smothered. Care is required to keep the beds in good condition, as to freedom from weeds, deposits and antagonistic kinds of life.

Seed Oysters.—The seed oyster is one which has grown sufficiently upon artificial collectors until it has reached perhaps one year of age or so, when it is frequently removed to other beds. It is said that about 40 per cent. of the oysters in the United States are obtained from natural beds, and the remainder are transplanted to places where the oyster does not breed or grow to advantage. Probably the most important factor of all, is the fact that the natural beds cannot supply the demand. For some time, oyster transplanting has been an industry carried out on a large scale in this country, and is now receiving much careful attention. The future will doubtless see still further attention to oyster culture.

Food Supply.—The oyster lives upon the various suspended matters contained in sea water, about 90 per cent. of the food being diatoms, or low forms of plant life, which are capable of growing on the mineral contents of sea water. This suspended matter reaches the stomach of the oyster, after having been

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filtered out from the water which passes through the gills. This process is well described by Prof. Brooks, of Johns Hopkins University, as follows:

"Every oyster in the bay is engaged day after day throughout the year, all day and nearly all night, in drawing into its shell a stream of water, filtering this through its gills, and then discharging this stream of water again. This stream can be traced for five or six feet away from the oyster by the disturbance it produces in the water. In fact, I think it is hardly an exaggeration to say that every drop of water that enters the Chesapeake bay from the Susquehanna river has a good chance to be filtered through the gills of an oyster before it reaches the ocean. After the oyster draws this stream of water into its shell, the water passes through microscopic pores over the surface of the gills, and out again through the vent pipe. During this process all microscopic organic life, or most of it, is filtered out. This is so true that those who manage aquaria have long been aware that water which has been filtered by the fresh-water mussel is peculiarly adapted to their uses, because it does not contain the germ of the green algæ which grows so profusely upon the sides of glass vessels, this material being so perfectly taken out by the mussel that the glass remains clean for a long time. The oyster does the same thing. These organisms, instead of going through the pores of the gills with the water, are entangled in the cement which the gland cells of the gills are continuously pouring out, and they are pushed along until they reach the mouth of the oyster, and are passed along into the stomach, where they are ultimately digested and converted into the wholesome substance of the oyster."

Bloating and Bleaching of Oysters.—In all countries, one of the characteristic features of the oyster industry is the frequent, though not universal, custom of removing the oysters with rakes or dredges, after they have grown to be of a sufficient size, from the oyster beds proper, and their placement for a day or two in drinking-houses, or floats. The latter are located ordinarily in coves or bays, or in the mouths of fresh-water streams, where the water is brackish. The object of this is to bloat, bleach or freshen the oysters. This is accomplished by the oysters drinking a comparatively large quantity of the brackish or fresh water,

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thereby, on account of difference in the specific gravity, causing them to become bloated, with the salty flavor, due to sea water, largely removed, and also giving them a much lighter color, due to its being filled with fresh water.

Fattening of Oysters.—The above-mentioned bloating process, which the oystermen say increases the market value of the product, but which is seriously objected to by devotees of fine oysters, is not to be confused with fattening, which, in a limited way, is done by transplanting to shallow bodies of salt water where the diatomaceous food is more abundant than around the natural beds. The latter process is an important branch of artificial oyster culture, which has long received attention in France and elsewhere.

Opportunities for Pollution.—Enough has been said above to make it plain that the oyster, even in natural beds, may at times be found in a water which is dangerously polluted with sewage, and that particularly dangerous pollution may be afforded by the custom of bloating the oysters by removing them just prior to their being marketed to special layings along shore. It is also apparent from what is said above that if disease germs are contained in the water in which the oysters are placed, there is a strong likelihood of these germs being filtered out by the oyster as the water passes through its gills and entering the body of the oyster.

We will now trace the available evidence as to the significance of disease germs entering the oyster body.

CONCERNING THE DETECTION OF TYPHOID FEVER GERMS IN OYSTERS AND IN WATER.

In the present state of the art, bacteriology does not afford ready and reliable means for the detection and isolation of the bacillus of typhoid fever in water, or in shellfish when present in such numbers as ordinarily exist in nature. With difficulty the numbers presented may be roughly approximated only in the laboratory when those present are excessively numerous due to artificial infection of the oyster or the water.

Accordingly, in the absence of direct means of studying the distribution of this germ in oysters and associated waters, it

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becomes necessary to study the problem indirectly. Along the latter line there are several ways of approaching the subject, viz:

(*a*) Evidence as to the longevity of the typhoid germ in sea water. This evidence is, of course, considered in connection with the time interval required for the passage of sewage from local outfalls to oyster beds in the vicinity.

(*b*) Topographical and physical evidence, such as distances, depths, volumes, tides, currents, etc., for studying each local problem as indicated in the foregoing paragraph.

(*c*) Comparison of the numbers of bacteria and organic contents of the water from above the oyster beds with that of sea water from unpolluted sources, paying special attention to the relative numbers of bacillus coli, which is the most prevalent species of bacteria in the intestines of man and other warm-blooded animals.

(*d*) Comparison of the bacillus coli contents of oysters (including the body, liquid and shells) from unpolluted sources with those from the locality in question.

(*e*) Evidence, so far as present methods of bacteriology permit, as to the behavior and duration of life of typhoid fever germs within and upon oysters which have been infected with this germ.

LIFE OF TYPHOID FEVER GERMS IN SEA WATER.

Available evidence, summarized in Table 1, indicates that this germ will live in unsterilized sea water in gradually decreasing numbers for periods ranging at least from about one week to one month, depending upon local conditions.

TABLE NO. 1.

Observer.	*Date.*	*Days after Infection when Germ was last Observed.*
De Giaxa,	1889	9
Foote,	1895	17
Klein,	1896	21
Burdoni-Uffredizzi and Zenobi,	1889 (?)	14
Herdman & Boyce,	1899	20
Field,	1904	10

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No observer has noted any signs of the typhoid germ multiplying in sea water.

According to Klein, germs of Asiatic cholera behave in a similar manner in sea water to typhoid germs, except that their continuance of life is apparently somewhat shorter.

Experiments have been made both by Klein and Field in which there was a gradual displacement of the infected sea water by uninfected sea water. The apparent result was a shortening of the life of the typhoid germ, but it is not clear how far this was a matter of elimination from the vessel by displacement of the water containing them.

In all other tests included in the above tabulation the infected sea water remained undiluted.

Generally speaking, it is seen that the life of the typhoid fever germ in salt water is very similar to that in fresh water, according to a diagram prepared by Whipple and embodying all of the best available data. Careful experiments recently made, jointly by Jordan, Russell and Zeit, indicate, however, that hostile influences within the local Chicago drainage canal water (fresh and sewage polluted) may cause the vast majority of typhoid germs to perish within three or four days. They specifically mention that these data are not intended to be representative of all conditions in all bodies of water. In this regard attention is directed to the fact that, due to the limits in accuracy of present laboratory methods. some disease germs, without any question, remain in the water for a longer period than indicated by the data here given. This obviously follows when consideration is given both to the difficulty in detecting typhoid fever germs when sparsely distributed in water and to the fact that the examinations in question involved the testing of a far smaller volume of water than is daily drunk by an oyster. In short, 90 per cent. of the typhoid germs disappear from infected water, according to different conditions, in from three to thirteen days, according to Whipple's diagram; and while the remainder without doubt gradually perish, there is no way at present of stating the period of survival of the last 1 per cent. or 0.1 per cent. The ques-

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tion of whether these last surviving germs are the most virulent ones in causing disease cannot now be answered.

BACTERIAL CONTENTS OF UNPOLLUTED SEA WATER.

Numbers of Bacteria.—Far distant from the land the water of the ocean, while by no means sterile, contains comparatively few bacteria, and all of these appear to be of a harmless kind. Thus, Levin found during an expedition to the Arctic regions that the water in that locality, according to the average of numerous analyses, contained 11 bacteria per cubic centimeter. This number he compared with 700 per cubic centimeter as the contents of sea water off the shores of Sweden.

In mid-ocean, in a voyage across the Atlantic, Minervini found that the numbers of bacteria ranged from 8 to 140 per cubic centimeter, and averaged about 60 per cubic centimeter. That these samples were not sterile is not so surprising as might appear at first sight, as the flora and fauna of ocean waters naturally furnish food for bacterial life. Thus Minervini records that in midocean several tests of the organic matter in sea water showed about twenty-five parts per million of oxygen consumed according to the Kubel method.

These numbers found in the middle of the Atlantic ocean correspond quite closely with those found about two and one-half miles or more distant from the coast by Russell in the Gulf of Naples and by Carta in the Gulf of Genoa.

The sediment on the bottom of the ocean was studied by Russell, and found to bear quite a close relation to the relative numbers in the water above, when the distance from shore exceeded that covered by the zone showing immediate effect of shore pollution. Within this zone, showing gradually decreasing effect of pollution, numerous bacteria were naturally found in the sediment.

Fisher also made numerous examinations of sea water on a prolonged ocean voyage to the Antilles, and found the bacterial contents to be generally similar to the above.

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Tests for Bacillus Coli.—Bacillus coli is the principal species, and by far the most abundant one in the intestines of man and other warm-blooded animals. Waters in which this germ is regularly absent in from one to ten cubic centimeters are found to be quite unpolluted, while the pollution of waters is now quite generally measured by the comparative numbers of bacilli coli present, according to methods recently formulated both in America and Great Britain.

The evidence is decisive that unpolluted sea water, remote from source of pollution, contains no bacillus coli. The most complete tests available were made for the Royal Commission on Sewage Disposal by Dr. Houston. Of thirty-five samples of sea water collected off the coast of Scotland within sight of land, but distant from any appreciable local pollution, thirty-four were found to contain no bacillus coli, even when 100 cubic centimetre portions were examined. The remaining sample gave a positive test with ten cubic centimetres.

This evidence is in accordance with the result of studies as to the distribution of numbers of bacteria and of bacillus coli, which have been made in this country of the waters of the Great Lakes some distance from land, especially in the vicinity of Toronto, Chicago, Milwaukee, Oswego, Buffalo and Cleveland.

Influence of Fish.—The question of fish comes up for consideration, with reference to bacillus coli being found in sea water at points considerably removed from sewage pollution. The evidence upon this point is not as complete as desired, but the observations of Amyot and Whipple indicate that bacillus coli is not a normal inhabitant of the intestines of fish. The studies of Russell and Bassett leave the matter in doubt, but Johnson found that where fish live for some time in polluted waters the intestines of the fish contain this germ. On the whole it is quite apparent that in unpolluted sea water bacillus coli coming from fish does not interfere seriously with the proposition that this germ is absent from such water.

Influence of Birds.—While the fœcal discharges of birds contain bacillus coli, the influence of this factor is apparently negligible, as a general proposition, upon the normal contents of deep sea water. Exceptions could appear only in chance samples, which are always to be avoided, as they are apt to lead to errors.

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Influence of Boats.—Refuse matter discharged from boats, in the opinion of some, is entitled to some weight as a factor influencing the quality of deep-sea water. At intervals this is probably true for small volumes, but the effect of such would be hardly appreciable in a comprehensive set of examinations.

Generally speaking, we may say that deep-sea water, distant from local sewers, is unpolluted according to bacillus coli tests.

BACTERIAL CONTENTS OF OYSTERS AND OTHER SHELLFISH TAKEN FROM UNPOLLUTED WATERS.

Exhaustive investigations upon this subject show that normally the oyster and other shellfish contain not only no specific disease germs such as that of typhoid fever, cholera, etc., but no bacillus coli, which, as already stated, is the prevailing organism in the intestines of man and other warm-blooded animals.

Dr. C. A. Fuller, formerly of Brown University, Providence, R. I., examined most carefully various portions of each of 200 oysters taken from unpolluted sources, as well as the liquid contained in the shell. In no instance did he find any bacteria which could be classed with the bacillus coli group.

Clark and Gage, who have investigated this matter extensively for the Massachusetts State Board of Health, concur in this conclusion, that bacillus coli is not a normal inhabitant of either clams or oysters.

Investigations leading to the same general inference have been made in various laboratories abroad, among which may be mentioned those of Klein, Houston and Hewlett.

In regard to the numbers of bacteria contained in the alimentary canal of oysters, Herdman and Boyce found from 0 to 5 in deep-sea oysters when testing on agar. Oysters from shops contained from 1 to 1,200 on agar, and from 1,700 to over 20,000 on sea-water gelatine.

LIFE OF TYPHOID FEVER GERMS IN LIVE OYSTERS IN SEA WATER.

Evidence upon this proposition has been obtained by several observers by putting oysters from unpolluted sources into small receptacles containing sea water infected with typhoid fever

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germs. From time to time examinations were made of the tissue, pallial cavity, alimentary tract, shell water, etc., of oysters. All observers have found that these disease germs penetrate the oyster body and live there in gradually decreasing numbers for various periods, ranging from about one week to about one month. In no case has anyone observed any signs of multiplication of typhoid germs within a live healthy oyster.

The principal data available upon this point are summarized in Table No. 2.

TABLE No. 2.

Investigator.	*Date.*	*Period. Days.*	*Remarks.*
Foote, ...	1895	30	Lived longer in oyster than in water.
Chantemesse, ...	1896	2	
Klein,.....	1896	17	No record of period of elimination.
Herdman & Boyce, ..	1899	14	Lived longer in water than in oyster.
Field, ...	1904	9	

In each case there is doubt about all of the typhoid germs having died within the period given; the records simply show the period up to the time when it was last observed.

Attention is called to the fact, as noted in the table, under "Remarks," that the comparative water differed with the different observers. Generally speaking, the life within the oyster was found to be very similar to that in sea water, as shown in Table No. 1, and the remarks made in that connection are also applicable here.

Herdman and Boyce made tests to ascertain how long a period was required in which to remove typhoid germs from infected oysters by subjecting them to a running stream of pure sea water. In seven days they found practically a total disappearance.

Field found, upon changing each day the infected oysters to a new clean tank of uninfected sea water, that the specific germ within the oysters (and also clams) could not be found after four days.

In each of the latter tests it is to be noted that the period was about one-half of that observed where the oysters remained in the originally infected water.

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As large numbers of typhoid germs were used in infecting the oysters in these tests, under conditions less favorable from a sanitary standpoint than ordinarily occurs in nature, these data show in this regard abnormally long periods of life. How far this aspect of the case goes to offset limitations in laboratory methods for the detection of the specific germ is a question which cannot be decided.

LIFE OF TYPHOID GERMS IN DEAD OYSTERS.

Field notes the result of some experiments in which he observed a well-defined growth of typhoid fever germs in some dead and dying oysters in sea water. These oysters were infected with enormous numbers of typhoid germs, and the conditions of the test would in this regard be rarely, if ever, duplicated in nature. The great mischief which could be done by one dead infected oyster among a lot of oysters, suggests at once that this matter should be investigated most thoroughly.

This possibility of growth of typhoid germs on dead shellfish is accepted by Dr. Niven and mentioned in his testimony before the Royal Commission, but the evidence to support it seems to us to be very limited.

Klein makes no mention of this question, but he records some observations indicating that the typhoid germ may multiply in cockles.

The question of growth of typhoid germs on cooked oysters, in instances where some but not all of a lot of infected oysters are killed by cooking in the same receptacle, is a matter worthy of serious thought.

The antagonism of other kinds of bacteria towards the typhoid germ is a very important matter in this connection, as it is quite possible that the ordinary kinds of bacteria present in an oyster at its death might normally prevent any appreciable growth of typhoid germs.

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RESISTANCE OF TYPHOID GERMS TO HEAT.

While typhoid germs form no spores and are killed by heat, it is not probable that heat as ordinarily applied in cooking oysters is nearly as great a safeguard against infection as is believed to be the case by many. Thus, Niven recognizes this in reviewing the data secured at Manchester, and Herdman and Boyce advise that oysters should be *sufficiently cooked,* that is, raised to the boiling point and kept there for at least ten minutes. Clark and Gage found that while exposure for five minutes to a temperature of 55 degrees Centigrade killed the great majority of typhoid germs, a few survived a temperature even of 80 degrees Centigrade. In some interesting experiments made by Hill it was found that the cooking of oysters as ordinarily practiced usually but not invariably killed typhoid germs.

An instructive report along this line of thought is that by Dr. Hamer, producing plausible evidence for attributing an outbreak of typhoid fever in certain districts of London, late in 1903, to fried fish. In Health Officer Murphy's letter of transmittal reference is made to similar outbreaks officially reported in 1898 by Health Officer Annes, of Huddersfield, and in 1899 by Health Officer Williamson, of Sandal Magna.

RELATIVE VITABILITY OF BACILLUS COLI AND BACILLUS TYPHOSUS IN WATER.

The longevity in water of these two species of bacteria is considered by bacteriologists to be quite similar. Bacillus coli is believed by some to be slightly more hardy and to live a trifle longer in water, although Houston found bacillus coli only after seven or eight days upon making a test with pure sea water artificially infected with this germ.

So far as this feature is concerned, the prevalence of bacillus coli appears to form a satisfactory general index for pollution, both in shellfish and in the water surrounding them.

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SANITARY CONDITIONS AS SHOWN BY INSPECTION OF LAYINGS OF OYSTERS AND OTHER SHELLFISH.

During the past ten years it is safe to say that a majority of the more prominent oyster beds, fattening grounds, etc., in this country and elsewhere have been examined with considerable care, either by official sanitary inspectors or by those who are competent to form a reliable general opinion as to their sanitary significance.

Similar attention has also been given to other shellfish, especially clams, the life history of which is more or less similar to that of the oyster. The reports of the Rhode Island Commissioners of Fisheries for 1899 and 1900 contain many interesting features about mode of growth, etc., of clams, particularly of the soft-shell variety.

Sanitary conditions can be adequately decided upon when the surroundings obviously show either freedom from all pollution or when the sources in question are very seriously and objectionably polluted. Unfortunately, many oyster layings come within the intermediate class, generally spoken of as "doubtful," and about which it is difficult to arrive at a correct and reliable opinion as to the probable degree of pollution on some occasions. Concerning this doubtful class, it is to be stated that information should cover reliably a wide range of conditions as to wind, weather, currents, and in general take into account all of the physical conditions, both subjectively and objectively, which bear a relation between population serving as a possible polluting factor and the body of water or beds serving for the cultivation of oysters or other shellfish.

Dr. Bulstrode, in his classical report "On Oyster Culture in Relation to Diseases," published in 1896, presented the first comprehensive record of the condition of practically all the oyster layings on the English and Welsh coasts. In these sanitary surveys very careful attention was paid to the various physical factors involved in the premises, and which, taken collectively, record in full what the English sanitarians speak of as "topographical conditions." Numerous maps were included in Dr. Bulstrode's report

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to facilitate an understanding of the actual conditions found. To appreciate fully the contents of this excellent report it is necessary to refer to the original. Here it is sufficient to say that many of the oyster layings were in such sanitary surroundings as to make it obvious to the investigator that the oysters or water from these sources were not of a perfectly safe hygienic character.

The State Board of Health of Massachusetts for the past five years has been giving much attention to this question. The report of their investigations, bearing directly and indirectly on all phases of this matter, has not yet been published. It is of interest, however, to note that in connection with some of their bacteriological reports they separate the sources from which shellfish were taken into the three general classes as above mentioned, and that the polluted and doubtful sources form a substantial proportion of the total, as indicated by the following table.

TABLE No. 3.

	Number of Sources.	
Character of Source.	*Shellfish.*	*Sea Water.*
Not polluted,	15	10
Doubtful,	22	19
Polluted,	6	4

An idea of the location of these several classes of sources is indicated in a special report of the board to the Massachusetts Legislature in May, 1902.

The oysters taken from the Providence river and Narragansett bay below the city of Providence, R. I., have been studied by Dr. C. A. Fuller, who has found that there are several oyster beds within a comparatively short distance of the outfall discharging the sewage effluent from the chemical precipitation works of the city of Providence.

Reference has already been made to the former pollution existing in the fattening beds in the neighborhood of Atlantic City, N. J., but which unsanitary conditions were corrected by order of the City Board of Health several years ago.

Dr. Brown, medical inspector of the Local Government Board of Ireland, has made a comprehensive report upon all of the

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principal oyster layings on the Irish coast. This important work has been done along lines similar to that by Dr. Bulstrode. In general it may be said that a considerable number of the principal oyster layings showed objectionable sanitary conditions with reference to possible or probable sewage pollution.

Dr. Bensel, sanitary inspector of the Board of Health of the city of New York, records the fact that many of the oysters taken from the general vicinity of New York city come from unsanitary sources, referring more particularly, however, to the floats and houses in which the oysters are bloated and bleached.

Reference has already been made to the contamination of portions of Jamaica bay in the vicinity of Lawrence, L. I.

In regard to the Great South bay, on the southern coast of Long Island, from which the so-called "Blue Point" oysters come principally, the last report of the U. S. Fish Commissioner records opportunities for pollution, especially in the floats near shore, although the oysters actually analyzed were free from sewage pollution.

In the recent report to the New York Legislature of the New York Bay Pollution Commission it is stated that about 1,000,000 bushels of market oysters and clams are taken annually from the lower New York bay (below the Narrows), almost exclusively from Gravesend bay (Kings county) and the southeast side of Staten Island (Richmond county). These shellfish, valued at about $900,000 annually, consist largely of oysters taken from private areas. The industry appears to be increasing, as the extent above stated is 30 per cent. to 40 per cent. greater than that given for 1901 in the report of the U. S. Fish Commission. The New York Bay Pollution Commission speaks of the present pollution of the bay as distinctly measurable, although not great; and further states that most of these shellfish beds are free from dangerous pollution, though some of them are found to be nearer sewer outfalls than is wise or proper. This commission also adds that analytical data show the water from the "drinking grounds" to be more polluted than that of the natural beds.

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BACTERIOLOGY OF COMMERCIAL SHELLFISH AND ASSOCIATED WATERS.

Although much work has been done on this subject, the evidence has not yet become clearly enough crystallized so that bacteriological data by themselves can be utilized practically by sanitary authorities in securing a better control of the shellfish placed upon the market.

At the outset it is necessary to consider that the oysters and other shellfish are not cultivated at long distances from the coast, where the waters are comparatively pure, as already indicated, but that they are grown comparatively near the shore at depths which enable them to be dredged, and where food is also available for their growth. This is especially true of the drinking grounds where they are bloated and bleached.

The evidence seems to be quite conclusive that oysters grow and fatten more readily in sewage polluted waters than they do in pure water, with its relatively sparse organic food.

Data are available in numerous instances showing the effect of sewage discharged under conditions where the pollution is so great that the oysters and other shellfish should not be cultivated there. But the evidence is very meagre in showing precisely what slighter amounts of sewage, if any, may reach waters in the vicinity of oyster layings and at the same time allow the oysters to be of satisfactory sanitary quality at all times.

From what has already been said it is apparent that sewage bacteria (including typhoid fever germs) disappear quite rapidly after their entrance into large bodies of water. This point is illustrated by the following table, showing the comparative numbers of bacteria at different distances from one of the two principal outlets in Boston Harbor for the discharge of the sewage (about fifty million gallons daily) of the metropolitan district of Boston.

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TABLE No. 4.

Distance from Deer Island Outlet.	*Bacteria per cubic centimeter.*
0 (at outlet),	2,240,000
500 feet,	121,000
1,000 "	35,000
3,000 "	1,800

Even more instructive and interesting are the records given in the next table, from Professor Clowe's report to the London county council, showing the rapid disappearance of the great majority of the sewage bacteria entering the lower tidal estuary of the Thames below the sewage precipitation works of the metropolitan district of London at Crossness. Shortly after the open sea near Nore Light is reached, it is seen that the numbers become comparatively low, approximating those found in the German ocean. This observation is still more interesting by virtue of the fact that in the Barrow Deep, about fifteen to twenty miles from the Nore Light, there are discharged on an average each day about 7,000 tons of sludge taken from the London sewage works, each cubic centimetre of which contains about 130,000,000 bacteria.

TABLE No. 5.

Locality.	*Distances from Crossness (Miles).*	*Bacteria per Cubic Centimeter.*
Effluent of sewage works,	0	7,442,857
Mucking light,	21.3	4,837
Mole haven,	24.3	3,431
Chapman light,	27.0	1,662
Yonklet creek,	29.5	711
Southend pier,	31.5	379
Garrison point,	35.5	381
Nore light,	35.8	186
Below the Nore,	39.3	145

It is needless here to record in much detail the analytical results of the several thousands of oysters and other shellfish which have been examined bacteriologically in various laboratories, especially those in Great Britain and in the United States. In brief, it may be said, as already mentioned, that the results

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of bacteriological analyses show very satisfactory confirmation of the results of careful sanitary surveys of existing local conditions when those conditions show clearly either the absence of pollution or the presence of well-defined pollution.

In regard to the intermediate class, where pollution is doubtful, the bacteriological evidence is of importance and in general the analytical data are in harmony with the results of sanitary surveys. This is not always true, however, as in some instances, particularly in such exhaustive observations as those made by Dr. Houston in England and by Prof. MacWeeney in Ireland. It was found that occasionally bacteriological data were interpreted on too rigid lines, and in other instances they gave a clue to polluting factors which were not noted during inspection.

One feature has come out very prominently, and that is that the test for bacillus coli should be made very thoroughly, to establish its identity with those coming from the intestines of men and animals, and that these tests should not be allowed to rest on partial or presumptive laboratory data.

A very valuable and instructive set of observations on the bacteriology of oysters from polluted sources recently published by the United States Fish Bureau, is that by Prof. C. A. Fuller, who found in the Narragansett bay that the bacillus coli contents of oysters gradually lessened as the distance increased from the outfall of the Providence sewage precipitation works, and that there were no observed bacillus coli in oysters eight miles or more distant from the outfall and away from the source of pollution. This paper also contains a very well prepared review of the literature on "Oyster Infection."

POLLUTION ON THE OUTSIDE OF OYSTERS.

Naturally there is much sediment, including bacteria, which is deposited from the water on to the beds in which oysters and other shellfish grow. From the sanitary standpoint it is significant that in the investigation of the outbreak of typhoid fever at Lawrence, L. I., Dr. Soper found by analysis that while 20 per cent. of the oysters were certainly polluted on the inside, as many

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as 70 per cent. were polluted on the outside of the shell. The widespread significance of this is that as the oysters were placed on the market, polluting material from the shells of a few oysters very likely, under some circumstances, might seriously pollute oysters which otherwise were perfectly safe. Whether or not this is generally true, or applicable only to the particular conditions in question, needs further careful study.

RELAYING OF OYSTERS.

For many years it has been the custom in France to relay oysters in disgorging tanks for a short time, with the view to causing the disappearance of disease germs before the oysters are placed on the market. This proposition was investigated in 1895 by Profs. Herdman and Boyce, and as the result of their observations they recommended that before the oysters are placed on the market they should be allowed to remain for a short time in water of unsuspected and well-established purity. There is unquestionably much merit in this proposition, as was testified to by a large number of competent observers in the hearings held by the Royal Commission on Sewage Disposal. As to the period of time required for polluted oysters to free themselves from all objectionable bacteria, the evidence is not conclusive. Most observers think that it would be safe to make the period two weeks, while a few prefer a period of three or even four weeks. The experts for the Royal Commission, however, at the time the last report of the Commission was published had made comparatively few experiments. Taking everything into consideration, the Royal Commission, while recognizing the importance of the relaying of shellfish, not only from the point of view of public health, but also from that of the oyster trade, did not feel disposed to committing itself upon the practicability of the method, but strongly recommended further investigations of the matter.

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SUMMARY OF EVIDENCE AS TO SHELLFISH POLLUTION WITH ESPECIAL REFERENCE TO NEW JERSEY CONDITIONS

Effect of Pollution.—The evidence already presented leaves no room for reasonable doubt that to a limited degree typhoid fever is transmitted by oysters, clams and some other shellfish which become infected in sewage-polluted waters. Asiatic cholera can be similarly transmitted. Where oysters or other shellfish are excessively polluted it appears that severe intestinal disorders, such as gastro-enteritis, may result within a comparatively few hours after eating the shellfish. The nature of the disease varies with the individuality of the person and the nature and extent of the pollution. This has been shown by some persons of a party, eating polluted shellfish from the same source, having had intestinal disorders of varying severity within a few hours, while others of the same party contracted typhoid fever in about ten days after the ordinary period of incubation of typhoid germs.

Careful and prolonged studies at London, Manchester and several other large cities in England lead to the conclusion that in the neighborhood of 10 per cent. of the total cases of typhoid fever in those cities has been caused by eating polluted shellfish. Along the British seacoast at quite a number of summer resorts the proportion is far greater than that above stated. In this country the extent to which polluted shellfish cause disease and death is not known definitely. It no doubt varies widely in different places and during different seasons in the same place. The fact that shellfish are eaten more generally in this country than in Great Britain, and that quite a portion of the shellfish are taken from polluted waters, suggests the probability that the public health is more menaced in this way here than abroad.

There are those who still believe that polluted shellfish cut very little figure, generally speaking, as regards the public health. Some of these persons appear to have formulated their views without knowledge as to general experiences or the evidence upon the subject. Others for commercial reasons attempt to minimize the evidence, and class it as a whole with some statements and conclusions which are obviously of questionable

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accuracy. There has been a substantial harmony in the conclusions reached by all who have investigated the subject carefully. The rumor appearing in medical journals about a year ago of a French commission reporting to the Secretary of the Navy that oysters could not transmit typhoid fever, was found to have been in error when the official report was carefully examined. To come to an agreement as to conclusions, it is necessary first to agree as to the evidence in the premises. With this end in view the preceding portion of this paper has been prepared.

Pollution in New Jersey.—In general terms quite a little is known about shellfish pollution in New Jersey as a result of observations by various persons interested officially or otherwise in sanitary matters. So far as is known, no systematic examination and record has been made of the facts in the case of all the important shellfish layings or drinking-grounds. From observation and perusal of random reports from various sources it is certain that some shellfish come from highly polluted waters in New Jersey. Newark bay forms, perhaps, the most striking example. The lower Passaic river is notoriously sewage-polluted, and the waters of Newark bay, into which it discharges, are manifestly unfit for growing shellfish or for the location of floats or drinking-grounds. Floats at and near the mouths of a number of rivers, such as the Rahway, the Raritan and neighboring creeks, are exposed to appreciable pollution, the extent of which varies widely. The pollution, however, comes from numerous small sources in the vicinity, as well as from the the sewage of cities situated some distance up-stream. The lower portion of New York bay, within the New Jersey boundary line, is not free from sewage pollution, although the evidence is very meagre as to the degree of pollution. The Shrewsbury and Navesink rivers, especially during the summer-time, receive the sewage of a large number of small communities, which pollutes some of the shellfish coming from this locality. Considerable sewage in places reaches the water-courses which extend along the New Jersey coast in the rear of numerous summer resorts. It is well known that the shellfish taken from waters in the vicinity of Atlantic City were polluted several years ago. Con-

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ditions, however, have been much improved by direction of the local Board of Health, although there seems to be uncertainty in the minds of some as to how thoroughly those directions are adhered to in all cases. In Maurice Cove, and a number of other places in southern New Jersey, shellfish are taken from waters not free from pollution. In New Jersey the vast scope of the shellfish proposition makes it especially urgent that the matter be treated thoroughly and equitably from all standpoints.

Classification of Pollution.—With reference to pollution, all shellfish and all waters from which they come may be classified in three groups, as follows:

1. Cases where the pollution is obviously great by inspection, and where the shellfish should not be permitted to be placed on the market.

2. Cases where pollution is either entirely absent or where it is so slight at most that it has no practical effect. These cases, too, may be determined largely by inspection with the aid of general experience.

3. All remaining cases are intermediate between the two above stated. They form what might be called the suspicious or occasionally polluted class. This forms, in most places in this country and abroad, a substantial proportion of all shellfish and shellfish waters. The truth in regard to them can be determined only upon thorough and prolonged investigation.

More Data Needed.—In the opinion of the writer more data are urgently needed in order that this whole local situation may be more thoroughly understood, and so that remedial measures may be applied effectively and equitably. While many cases can be disposed of quite readily as coming under the first or third group above mentioned, it has been the universal experience elsewhere that the intermediate class is a difficult one to treat, and must be carefully studied in order that steps in advance may be properly taken. This is shown clearly by the fact that the complete reports upon this subject have not yet been made by the Royal Commission on Sewage Disposal in Great Britain or by the Massachusetts State Board of Health, notwithstanding the fact that they have been giving the subject in connection with

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allied matters careful thought during the past five years or more. The difficulty in handling this general subject at present is that the data as to various individual cases are too meagre. To get the controlling facts placed before those who have the authority to act in this matter by means of scattering analyses here and there, without corresponding evidence as to the source and extent of pollution, effect of tide, wind, currents, dilution and other data of an engineering nature, is almost futile in many cases. It is frequently out of the question to base an adequate opinion upon a single inspection or upon a limited number of analyses, on account of such data not being representative of all conditions met with, and therefore perhaps misleading to a serious degree. Improved methods of study of this problem are urgently needed, and the results of such improved methods should be applied most exhaustively in order that this matter may be clearly put on a fair basis. One of the principal topics requiring thorough study is the practicability of relaying oysters coming from slightly polluted sources in pure water under such conditions and for such a period of time that the objectionable bacteria may be certainly eliminated. It would probably require from $10,000 to $15,000 to ascertain the main facts in the case of more important New Jersey conditions with a thoroughness such as have been done at several places elsewhere. Such investigations made thoroughly, and the corrective measures applied equitably from all standpoints, would be a decided sanitary benefit to the public and of financial benefit to the shellfish trade.

Relation of Shellfish Pollution to Sewage Disposal Problems.—This matter has not ordinarily been considered in this country as yet, other than in a superficial way. There are some exceptions, such as Baltimore, where a recent Legislature enabling act as to improved sewerage forbids the entrance into the waters of the Chesapeake bay of sewage before it is most thoroughly purified. It is clear that the time is approaching when the relative aspects of these matters must be carefully weighed. Speaking generally, it seems apparent that where small sewage disposal projects are associated with large shellfish industries the latter, as a business proposition, should not be injured ir destroyed when a relatively

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small sum of money will produce a satisfactory purification of the sewage. On the other hand, where the question involves a very large center of population, with its corresponding cost for sewage purification beyond the point of preventing gross nuisances, then it seems that the small shellfish industry should become subservient to the larger public interests, and should be abolished after receiving such compensation as it may be legally entitled to. Where the relative money values of the shellfish industry and of the associated sewage disposal project approximate each other, it becomes a matter for careful consideration and equitable adjustment for each locality.

Those communities having soon to build sewage disposal works obviously are entitled to know as soon as practicable what will be the definite attitude of the State authorities as to their particular project from the standpoint of shellfish pollution.

Remedies for Pollution.—There is no rule-of-thumb method by which the pollution of shellfish by sewage can be regulated. It depends much upon local conditions. In connection with what is said above as to sewage purification, it may be added that septic tanks, settling basins and coarse-grain filters (contact filters or sprinkling filters of broken stone, coke or cinders) receiving raw sewage will ordinarily remove in the neighborhood of two-thirds of the bacteria contained in the original sewage. Growths of bacteria which do not produce disease frequently obscure entirely the facts as above expressed. By combining the preliminary treatment involving sedimentation, with or without septic treatment, and coarse-grain filtration there may be removed about 90 per cent. of the bacteria in the raw sewage. Chemical precipitation involving a thorough coagulation will remove also in the neighborhood of 90 per cent., although as generally practiced the removal frequently is as low as 80 per cent. Intermittent filtration through sand, such as practiced in many places in New England, when carefully carried out will effect the removal of about 98 per cent. to 99.9 per cent. of the bacteria. A similar result may be obtained by subjecting the non-putrescible effluent of a coarse-grain filter to a final treatment generally similar to the treatment of polluted river waters, either in sand filters or in

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mechanical filters. Copper compounds, oxychlorides and other chemicals have been studied at intervals for some years for the purpose of killing disease germs in sewage and sewage effluents. The general subject was much discussed a dozen years ago in Germany, during and after the cholera epidemic at Hamburg. Copper sulphate as a germicide has been widely studied and discussed in this country during the past year or two. In general it appears that a dose of 1 to 50,000 in the course of six to twelve hours will kill a great majority of typhoid germs, perhaps 90 per cent. to 99 per cent. The results vary widely, depending largely upon the vitality of the disease germs. Temperature is an important factor, as the doses have to be materially increased as the water or sewage approaches freezing. While a dose of 1 to 1,000,000 will kill a large per cent. of disease germs, it seems to be a fact that with any dose which economy permits it is hardly possible to kill all of the disease germs. Whether these very resistant forms are the most virulent in producing disease is an important question upon which but little is known at present. Copper sulphate apparently can be of service in some cases where sewage must be freed from disease germs before reaching shellfish layings. It does not, however, seem probable that the treatment will come into general use.

Very truly yours,

GEORGE W. FULLER,
Sanitary Engineer.

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Sewerage Statistics

OF THE

Municipalities in the State of New Jersey.

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Sewerage Reports of the Municipalities in the State of New Jersey, 1905.

FORM OF BLANKS.

SEWERAGE REPORT

of the .....of .....in the county of .....in the State of New Jersey.

A. Combined sewers.

1. Number of miles laid, ...
2. Area drained, ...
3. Population cared for, ...
4. Number of houses drained, ...
5. Number of factories drained, ...
6. Kinds of factories, ...
7. Number of outlets, ...
8. Estimated discharge, ...
9. Kind of grades, ...
10. Kind of flushing, ...
11. When constructed, ...
12. What new work planned, ...
13. Annual expense for care, ...
14. Kind of care, ...
15. System owned by, ...

B. Separate Sewers.

1. Number of miles laid, ...
2. Area drained, ...
3. Population cared for, ...
4. Number of houses drained, ...
5. Number of factories drained, ...
6. Kinds of factories, ...
7. Number of outlets, ...
8. Estimated discharge, ...
9. Kind of grades, ...
10. Kind of flushing, ...
11. When constructed, ...
12. What new work planned, ...
13. Annual expense for care, ...
14. Kind of care, ...
15. System owned by, ...

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C. Storm Water Drains.

1. Number of miles laid, ...
2. Area drained, ...
3. Number of outlets, ...
4. Kind of grades, ...
5. What new work planned, ...
6. When constructed, ...
7. System owned by, ...

D. Manner of Disposal.

1. Name of water receiving discharge, ...
2. Estimated discharge, ...
3. Kind of treatment, ...
4. Capacity of septic tank, ...
5. Time of flow in tank, ...
6. Velocity of flow in tank, ...
7. Frequency of cleaning tank, ...
8. Kind of filter beds, ...
9. Sizes and number of filter beds, ...
10. Material of beds, ...
11. Depth of beds, ...
12. Method of distribution on beds, ...
13. Kind of under drains, ...
14. Cleaning of beds, ...
15. Cost of maintenance of plant, ...
16. Extension planned, ...
17. Amount of ground water, ...
18. Ownership of disposal system, ...
19. Date of construction, ...
20. What use made of chemicals, ...

E. Water Supply.

1. Source of supply, ...
2. Daily individual consumption, ...
3. Who owns supply, ...

F. Private Sewers.

1. Number of private sewers, ...
2. Water discharged into, ...
3. Number of houses accommodated, ...
4. No. of private purification plants, ...

G. Pollution.

1. Condition of waters, ...
2. Places of nuisance, ...
3. Source of pollution, ...
4. Amount of pollution, ...

H. Remarks.

Give any information as to sewerage or pollution not included above; a brief description of the sewerage system; the need of sewers or extensions; a brief description of disposal plants and their operation, and any unusual features.

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REPORTS.

ATLANTIC COUNTY.

CITY OF ABSECON.

Samuel Johnson, City Clerk, reports no public sewers and four private sewers from four houses discharging into Absecon creek. The water supply is from Baker's mill pond, and is owned by the Pleasantville Water Company.

CITY OF ATLANTIC CITY.

P. F. Stoy, Mayor, reports combined sewers, none; separate sewers, forty miles laid, draining four square miles approximately. Population is 40,000 for nine months, and 350,000 for three months. Seven thousand houses and no factories drained. Two outlets. Estimated discharge, 8,000,000 gallons per day for three months, and 4,500,000 gallons per day for nine months. No flushing. System constructed gradually since 1882. New work planned, extensions and reconstruction as required. System owned by private corporation.

Storm water drains: Storm water flows in street gutters, discharging into ocean or thoroughfares or ditches in the meadows, either directly or through comparatively short lengths of wooden box drains. City has no storm water drainage system as ordinarily defined.

Disposal: The sewage is discharged into Beach thoroughfare, the estimated discharge being a maximum of 8,000,000 gallons per day for three months. There is no treatment of the sewage. The volume of water passing the mouth of the sewer outlets, as determined by current meter measurements, in 1903, was 839,000,000 gallons.

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Water supply: The source of water supply is Absecon creek and artesian wells. The supply is owned by the city.

CITY OF BRIGANTINE.

A. B. Smith, Mayor, reports no sewerage system, private or public, and no water supply.

CITY OF EGG HARBOR CITY.

V. P. Hoffman, City Clerk, reports water supply owned by Egg Harbor City Water Company, the source of supply being artesian wells, and the daily consumption being 65,000 gallons.

The city has no sewerage system. Two ditches have been constructed for the removal of storm water; one, one and one-quarter miles long, and the other, one-half mile long.

CITY OF NORTHFIELD.

No sewers.

CITY OF PORT REPUBLIC.

No sewers.

CITY OF SOMERS POINT.

G. Frank Cope, Mayor, reports that there is no sewerage system at present, but some hope that in the near future the city will be able to obtain one. He also reports that the water supply is obtained from Pleasantville.

CITY OF SOUTH ATLANTIC CITY.

Henry F. Gertzen, Mayor, reports no sewerage system. The water supply is from an artesian well owned by the city, and the daily consumption is 27,000 gallons for 150 population.

CITY OF VENTNOR CITY.

No report.

TOWN OF HAMMONTON.

James L. Donnelly, Town Clerk, reports no sewerage system; that water plant is owned by the town; that six miles of water mains are laid; that the question of a sewerage system will probably be taken up for consideration in a few years.

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BOROUGH OF LINWOOD.

Lewis Steelman, Mayor, reports no sewerage system.

BOROUGH OF LONGPORT.

R. N. Elliott, Mayor, reports about one and one-half miles of combined sewers owned by Longport Water and Light Company, discharging at fourteen outlets, into Beach thoroughfare, draining fifty-six houses, with a population varying from 150 to 1000, according to season. No factories. The sewers were constructed at various times since 1886. No separate sewers. No storm water drains. Water supply owned by Longport Water and Light Company. Source of supply, artesian well. Estimated daily individual consumption, 100 gallons.

BOROUGH OF PLEASANTVILLE.

William I. Garrison, Mayor, reports no sewers. Water supply from artesian well owned by Pleasantville Water Company.

TOWNSHIP OF BUENA VISTA.

Douglass Reed, Township Clerk, reports no sewerage system.

TOWNSHIP OF EGG HARBOR.

George S. Winner, Township Clerk, reports no sewers.

TOWNSHIP OF GALLOWAY.

No sewers.

TOWNSHIP OF HAMILTON.

No sewers, except at Mays Landing, where there is a sewer draining the county buildings and some terra-cotta storm drains in streets.

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TOWNSHIP OF MULLICA.

John T. Irving, Town Clerk, reports no sewers.

TOWNSHIP OF WEYMOUTH.

Anderson Campbell, Chairman of Township Committee, reports no sewers or water supply.

BERGEN COUNTY.

CITY OF ENGLEWOOD.

Samuel F. Gold, superintendent of the Englewood Sewerage Company, by request of Mayor D. F. Platt, reports: Combined sewers, none; separate sewers, 18.72 miles laid, draining one and one-half square miles; population, 8,000; number of houses, 750; factories, 3; ice plant, clothing and paper tubes; one eighteen-inch outlet; flushing by thirty-five flush tanks; system constructed in 1887; no new work planned at present; sewer cared for by one inspector at fifty dollars per month, inspecting connections and keeping sewer in order. Discharge is into Overpeck creek at one point 1.5 miles below city, without treatment. System owned by Englewood Sewerage Company. Storm water drains laid by city. Water supply furnished by Hackensack Water Company.

VILLAGE OF HACKENSACK.

There are about 13 miles of combined sewers, five of brick and eight of pipe, discharging at five points into the Hackensack river, without treatment. The water-supply is furnished by the Hackensack Water Company.

VILLAGE OF RIDGEFIELD PARK.

Separate sewerage system, discharging at one point, without treatment, into Hackensack river.

BOROUGH OF ALLENDALE.

Walter Dewsnap, Mayor, reports no sewerage system.

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BOROUGH OF ALPINE.

Franklin W. Hopkins, Mayor, reports no sewerage system. The borough is in the watershed of the Hackensack Water Company and the streams are kept free from pollution by the company.

BOROUGH OF BERGENFIELD.

No sewers.

BOROUGH OF BOGOTA.

Separate system of sewers, owned by borough, discharging at one outlet into Hackensack river, without treatment.

BOROUGH OF CARLSTADT.

No sewers, excepting about 1,800 feet of storm drains.

BOROUGH OF CLIFFSIDE PARK.

No report; private sewers, about 1,500 feet laid, discharging at one point, without treatment, in Hudson river.

BOROUGH OF CLOSTER.

No sewers.

BOROUGH OF CRESSKILL.

No sewers.

BOROUGH OF DELFORD.

H. A. Bingham, Borough Clerk, reports that a sewerage system is being constructed, and will be completed during the present winter. The disposal system, consisting of a septic tank, is to be constructed according to plans approved by the Commission.

BOROUGH OF DEMAREST.

J. H. Z. Demarest, Mayor, reports no sewerage system or water supply.

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BOROUGH OF DUMONT.

Frank Hill, Borough Clerk, reports no sewerage system; water supply furnished by Hackensack Water Company.

BOROUGH OF EAST RUTHERFORD.

George A. Duncan, Borough Clerk, reports no sewerage. The matter of installing a sewerage system is being agitated and will probably take some definite form shortly.

BOROUGH OF EDGEWATER.

About three miles of private sewers, discharging, without treatment, in Hudson river.

BOROUGH OF ENGLEWOOD CLIFFS.

No sewers.

BOROUGH OF ETNA.

No sewers.

BOROUGH OF FAIRVIEW.

No sewers.

BOROUGH OF FORT LEE.

John C. Abbott, Mayor, reports no sewers. The question of providing sewerage has been considered and map and estimates of costs made by the borough engineer. The borough is trying to secure an outlet through private property. One portion of the borough is in need of sewerage and the borough authorities are trying to provide it.

BOROUGH OF GARFIELD.

No sewers, except 900 feet of storm drain to drain railroad crossing.

BOROUGH OF GLEN ROCK.

William H. Berry, Mayor, reports no sewerage system; some connections have been made with the Ridgewood sewerage system.

BOROUGH OF HARRINGTON PARK.

No sewers.

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BOROUGH OF HASBROUCK HEIGHTS.

W. S. Lawrence reports no sewerage system.

BOROUGH OF HAWORTH.

No sewers.

BOROUGH OF LEONIA.

J. H. Clark, Assessor, reports no public sewerage system; three private sewers accommodating 100 houses discharging into Overpeck creek, without treatment. Sewers owned by Leonia Sewer Company, Central Sewer Company and North Side Sewer Company.

BOROUGH OF LITTLE FERRY.

Oswald Merhoff, Mayor, reports no sewerage system except one ditch emptying into the Hackensack river.

BOROUGH OF LODI.

No sewers.

BOROUGH OF MAYWOOD.

J. R. Davies, President of Council, reports no sewerage system. The question of providing sewerage for the borough is being considered informally. One section of the borough is in need of sewerage.

BOROUGH OF MIDLAND PARK.

R. H. Wortendyke, Mayor, reports no sewers.

BOROUGH OF MONTVALE.

E. P. Serrill, Borough Clerk, reports no sewerage.

BOROUGH OF NORTH ARLINGTON.

No sewers.

BOROUGH OF NORWOOD.

No sewers.

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BOROUGH OF OAKLAND.

No sewers.

BOROUGH OF OLD TAPPAN.

J. H. Lachmond, Jr., Borough Clerk, reports no sewers.

BOROUGH OF ORVIL.

No sewers.

BOROUGH OF PALISADES PARK.

No sewers.

BOROUGH OF PARK RIDGE.

No sewers.

BOROUGH OF RIDGEFIELD.

A. G. Troup, Mayor, reports no public sewers, one private sewer.

BOROUGH OF RIVERSIDE.

No public sewers. A few private sewers, discharging into Hackensack river.

BOROUGH OF RUTHERFORD.

One combined sewer, 1,800 feet long, of 18-inch cement pipe; about 13 miles of separate system; 1,200 feet of brick storm drain; four outlets, three in Passaic river and one in Berry's creek; estimated daily discharge: Passaic river, 75,000 gallons; Berry's creek, 180,000 gallons. Water-supply from East Jersey Water Company.

BOROUGH OF SADDLE RIVER.

Jacob O. Ackerman, reports no sewers.

BOROUGH OF TENAFLY.

J. Ostermann, Jr., Mayor, reports no sewerage system; water supply from the Hackensack Water Company.

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BOROUGH OF UPPER SADDLE RIVER.

No sewers.

BOROUGH OF WALLINGTON.

No report.

BOROUGH OF WESTWOOD.

Thomas Brinckell, Mayor, reports no sewers; water supply from Hackensack Water Company.

BOROUGH OF WOODCLIFF.

J. H. Ackerman, Mayor, reports no sewers.

BOROUGH OF WOODRIDGE.

No report.

TOWNSHIP OF FRANKLIN.

John W. Courter, Chairman of Township Committee, reports no sewerage.

TOWNSHIP OF HARRINGTON.

No sewers.

TOWNSHIP OF HILLSDALE.

No sewers.

TOWNSHIP OF HOHOKUS.

G. H. Carpenter, Township Clerk, reports no sewers.

TOWNSHIP OF LODI.

F. Switz, Chairman of Township Committee, reports no sewers.

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TOWNSHIP OF MIDLAND.

No sewers.

TOWNSHIP OF ORVIL.

Russell Kinniburgh, Borough Clerk, reports no sewers; there has been some complaint of pollution of Saddle river, which is receiving local attention.

TOWNSHIP OF OVERPECK.

Private sewers, with about 80 house connections, discharging in Hackensack river without treatment.

TOWNSHIP OF PALISADES.

Milford Streeter, Chairman of Township Committee, reports no sewers; water-supply from Hackensack Water Company.

TOWNSHIP OF RIDGEWOOD.

Combined system in one-half of township. Purification by septic tank, contact and wave beds. Construction completed in 1905. Discharge into Hohokus creek. House connections now being made.

TOWNSHIP OF RIDGEFIELD.

No sewers.

TOWNSHIP OF SADDLE RIVER.

No report.

TOWNSHIP OF TEANECK.

William Bennett, Chairman of Township Committee, reports no sewers; some private ones of houses along the Hackensack river discharge sewerage into the river. Part of the township will soon need sewerage.

TOWNSHIP OF UNION.

Charles Rehwoldt, Chairman of Township Committee, reports no sewerage system; water-supply is being constructed by the township. Complaint is made of the condition of the Passaic river as ruining the best residential section of the township.

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TOWNSHIP OF WASHINGTON.

George Peck, Chairman of Township Committee, reports no sewerage system or water supply.

BURLINGTON COUNTY.

CITY OF BEVERLY.

No sewers, except private drains, discharging in Delaware river.

CITY OF BORDENTOWN.

Private sewers, discharging into Thorntown and Crosswicks creeks. Plans for sewer to relieve Thorntown creek of sewage have been approved.

CITY OF BURLINGTON.

City sewered with separate system owned by Burlington Sewerage Company. Disposal by pumping plant, septic tank, primary contact beds and secondary sand filters. Effluent reaches Delaware river by way of city ditch.

BOROUGH OF FIELDSBORO.

Charles H. Fennimore, Clerk, reports no sewerage system. No water supply.

BOROUGH OF PEMBERTON.

J. B. Hankins, Secretary of the Pemberton Township Water Sewerage and Light Company, reports no sewers owned by the borough; the company owns five-eighths of a mile of ten-inch terra-cotta sewer with forty-five house connections emptying into an open well in a field, disposal being by filtering through the ground; water-supply owned by the company taken from Rancocas creek. The total individual consumption being estimated at twenty to twenty-five gallons.

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BOROUGH OF RIVERTON.

F. G. Brown, Mayor, reports no combined sewers; a separate system of about four and two-third miles mostly eight and ten-inch pipe, draining about 150 acres, with 250 house connections, no factory connections, discharging from two outlets into the Delaware river; constructed in 1902 and owned by the borough of Riverton. Flushing is done by automatic flushing tanks. An automatic flush worked by the tides has been designed for clearing the western outlet every ten hours through the sixteen-inch cast-iron discharge pipe, extending 350 feet into the river, but has not yet been completed. In addition to this there are fifteen private sewers serving nineteen houses and discharging into the Delaware river.

TOWNSHIP OF BASS RIVER.

No sewers.

TOWNSHIP OF BEVERLY.

William T. Baggs, Chairman of Township Committee, reports no sewerage.

TOWNSHIP OF BORDENTOWN.

William J. Terrell, Chairman Township Committee, reports no sewers.

TOWNSHIP OF BURLINGTON.

No sewers.

TOWNSHIP OF CHESTER.

No sewers.

TOWNSHIP OF CHESTERFIELD.

C. E. Wallace, Chairman of Township Committee, reports no sewers.

TOWNSHIP OF CINNAMINSON.

Clayton Conrow, Chairman of Township Committee, reports no sewer system. The Riverton & Palmyra Water Company supplies part of the township.

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TOWNSHIP OF DELRAN.

Charles W. Beatty, Chairman of Township Committee, reports no sewers.

TOWNSHIP OF EASTAMPTON.

Thomas H. Shinn, Chairman of Township Committee, reports no public sewers. Two private sewers, discharging into Rancocas creek, without treatment.

TOWNSHIP OF EVESHAM.

No sewers.

TOWNSHIP OF FLORENCE.

No sewers.

TOWNSHIP OF LUMBERTON.

A. Engle Haines, Chairman of Township Committee, reports no sewerage system. Water works in process of construction.

TOWNSHIP OF MANSFIELD.

A. W. Dobbins, Township Committee, reports no sewerage system; artesian-well water-supply owned by Columbus Water Company; daily individual consumption about 10 gallons.

TOWNSHIP OF MEDFORD.

No sewers.

TOWNSHIP OF MOUNT LAUREL.

Budd M. Horner, Chairman of Township Committee, reports no sewers.

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TOWNSHIP OF NEW HANOVER.

George C. Davis, Chairman of Township Committee, reports one-quarter of a mile storm-water drain laid by township in 1904, discharging into Jones pond; water supply owned by Wrightstown Water Company.

TOWNSHIP OF NORTHAMPTON.

No report.

TOWNSHIP OF PALMYRA.

James E. Russell, Chairman of Township Committee, reports no sewerage. A sewerage system is needed and public sentiment in favor of a system is growing; 1½ miles of storm-water drains have been laid by the county, draining 100 acres and discharging in one outlet into Pensauken creek. It was constructed in 1903 and 1904.

TOWNSHIP OF PEMBERTON.

M. W. Hargrove, Township Clerk, reports one half-mile private sewer, discharging at one outlet into the north branch of Rancocas creek; accommodating ten houses and 100 people; constructed in 1880.

TOWNSHIP OF RIVERSIDE.

Township Committeeman William Mathias reports no sewerage system, although it is hoped in the near future that one will be installed.

TOWNSHIP OF SHAMONG.

John Miller, Chairman of Township Committee, reports no sewers

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TOWNSHIP OF SOUTHAMPTON.

No sewers.

TOWNSHIP OF SPRINGFIELD.

E. H. Lippincott, Chairman of Township Committee, reports no sewers, excepting one-eighth of a mile of storm-drain owned by township and about four miles of storm-water terra cotta drains on the Pierre Lorillard farm.

TOWNSHIP OF TABERNACLE.

J. Cooper Haines, Chairman of Township Committee, reports no sewers.

TOWNSHIP OF WASHINGTON.

Thomas K. Sooy, Township Committeeman, reports no sewers and no water-supply.

TOWNSHIP OF WESTAMPTON.

Clarence W. Loveland, Chairman of Township Committee, reports no sewers.

TOWNSHIP OF WILLINGBORO.

Elwood Hart, Chairman of Township Committee, reports no sewers.

TOWNSHIP OF WOODLAND.

No report.

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CAMDEN COUNTY.

CITY OF CAMDEN.

L. E. Farnham, City Engineer, reports: Combined sewers, 58.89 miles laid; six square miles drained; 70,000 population cared for; 17,500 house connections, estimated; thirty-five factory connections, including woolen, iron, chemical, machine, candy, soap and dye factories; fourteen outlets; estimated dry weather discharge, 16,000,000 gallons; no flushing; constructed from year to year since 1857. Three new trunk sewers planned. Annual expense for care, about $3,000. Under control of Street Department. Care of system is by contract work—cleaning and repairing. System owned by the city.

No separate sewers or storm water drains.

Sewage discharged into Delaware river and Cooper's creek. No treatment.

Water supply by artesian wells owned by city of Camden and by Stockton Water Company. The daily individual consumption is 150 gallons.

No private sewers, excepting those connecting with public sewers.

No complaint of pollution, excepting in the Delaware river, which receives sewage from the city of Philadelphia.

The Board of Health and a committee of citizens are planning to abolish the meadows in the city by building a sewer through them, with the idea of making the land marketable, and preventing the breeding of mosquitoes. The legal questions and the probable cost of $250,000 have prevented the accomplishment of this in past years.

CITY OF GLOUCESTER CITY.

John H. Boylan, Mayor, reports: Combined sewers, twelve and three-quarter miles laid; one square mile drained; population of 8,055 cared for; 1,900 houses drained; seven factories connected,

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including rug mill, gingham mill, electric-light plant, file works, coffee roasting plant and ice manufacturing plant. Seven outlets. Flushing by storm water and water from fire hydrants. System constructed at different times within last thirty years. New work planned, consisting of 300 feet brick sewer, and 930 feet of terra-cotta sewer. System owned by the city. The sewage is discharged into Delaware river.

Separate sewers: three factories, a spinning mill, print works and a Welsbach light works, are drained by separate sewers into the Delaware river.

Water supply: about 70 per cent. of water supply is from artesian wells and the balance from Newton creek. The supply is owned by the city.

BOROUGH OF AUDUBON.

No sewers.

BOROUGH OF CHESILHURST.

No sewers.

BOROUGH OF COLLINGSWOOD.

Separate sewerage system, owned by Collingswood Sewerage Company. Disposal by septic tank, contact beds and wave beds, discharging into Newton creek.

BOROUGH OF HADDONFIELD.

Separate sewerage system, owned by borough. Disposal by septic tank and sand filters, discharging into Cooper's creek.

BOROUGH OF HADDON HEIGHTS.

Joseph A. Patton, Borough Assessor, reports that there are no sewers. The question of providing sewers is being agitated, and preliminary plans and estimates have been made.

The water supply is from the United Water Company, owned by Public Service Corporation.

BOROUGH OF MERCHANTVILLE.

William Longstreth, Mayor, reports no sewers. A sewerage system is being designed for the borough.

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BOROUGH OF OAKLYN.

No report; small sewerage system, discharging in Newton creek without treatment.

BOROUGH OF WOOD-LYNNE.

George Streitz, Mayor, reports a separate sewerage system of one and one-third miles of sewers laid, draining thirty-eight acres, caring for 300 population; eighty house connections and no factory connections; flushing by roof drainage; constructed in 1901; owned by the borough.

The system discharges into the north branch of Newton creek, one mile above Delaware river.

The water supply is from the Camden city artesian wells.

TOWNSHIP OF CENTRE.

William F. Miller, Chairman of Township Committee, reports no sewers.

TOWNSHIP OF CLEMENTON.

Jacob C. Lippincott, Chairman of Township Committee, reports no sewers.

Part of the township is supplied with water—in the town of Clementon. Other small water companies have received permission to lay pipes, but have not yet done so.

TOWNSHIP OF DELAWARE.

J. W. Matlack, Chairman of Township Committee, reports no sewers.

TOWNSHIP OF GLOUCESTER.

J. M. Stetser, Chairman of Township Committee, reports no sewers, excepting 1,200 feet of storm drain of five-inch terra-cotta pipe, constructed in 1903, discharging at one outlet, and draining twenty-five acres; owned by the township.

TOWNSHIP OF HADDON.

Joseph A. Patton, Township Clerk, reports no sewers. The township has the privilege of connecting with the Haddonfield

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sewers, the contract having been made when the franchise was granted to allow the borough of Haddonfield to place its disposal plant within the limits of the township.

The water-supply is furnished by the Collingswood Water Company, owned by the Public Service Corporation.

TOWNSHIP OF PENSAUKEN.

Henry S. Gaskill, Chairman of Township Committee, reports no sewers.

TOWNSHIP OF VOORHEES.

No report.

TOWNSHIP OF WATERFORD

H. N. Gillon, Chairman of Township Committee, reports no sewers.

TOWNSHIP OF WINSLOW.

J. G. Stock, Chairman of Township Committee, reports no sewers.

CAPE MAY COUNTY.

CITY OF CAPE MAY.

Combined sewerage system. Sewage discharged into Delaware bay through force main from central pumping station, without treatment.

CITY OF OCEAN CITY.

About five miles of separate sewers, owned by Ocean City Sewer Company, with 300 house connections, discharging, without treatment, into Great Egg Harbor bay.

BOROUGH OF ANGLESEA.

Augustus Hilton, Mayor, reports no combined sewers. Separate system; seven miles of pipe laid, caring for a population of

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300 in winter and 1,000 in summer; fifty houses out of eighty are connected; no factories; four outlets; estimated discharge, from 15,000 to 50,000 gallons; flushing by hose; constructed in 1903; annual expense for care, $300, for superintendent appointed by borough; system owned by borough; about 16,000 feet of extensions planned.

BOROUGH OF AVALON.

Gilbert S. Smith, Mayor, reports: Combined sewers, none. Separate system; two and three-quarter miles of main, draining about seventy acres; caring for winter population of 100; summer population of 1,000; fifty-four house connections; no factory connections; three outlets; flushing by flush tanks and hose; system constructed in 1900 and 1903; no new work planned; system owned by borough; discharge into Beach creek, without treatment. Water supply from artesian well owned by borough.

BOROUGH OF HOLLY BEACH CITY.

No sewers.

BOROUGH OF SEA ISLE CITY.

Combined sewerage system, discharging into Ludlam Thorofare and Ludlam bay, without treatment. Owned by Sea Isle City Sewerage Company.

BOROUGH OF SOUTH CAPE MAY.

No report.

BOROUGH OF WEST CAPE MAY.

W. L. Cummings, Mayor, reports no sewers, excepting about six or seven houses drained by a sewer owned by Cape May city, discharging into Cape Island creek; a system of drainage to discharge into Cape Island creek is contemplated.

The water supply is received from Cape May city.

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BOROUGH OF WILDWOOD.

Latimer R. Baker, Mayor, reports: A combined system of sewers about three and one-half miles, draining about 150 acres; caring for about 10,000 population in summer season; 200 house connections; no factory connections; two outlets; flushing by flush tanks; constructed from 1896 to 1901; system owned by borough.

Water supply from artesian wells owned by Wildwood Water Company.

BOROUGH OF WOODBINE.

B. A. Palitz, Superintendent, reports no sewers, excepting about two-thirds of a mile of separate sewers, draining a hat factory.

Water supply is from artesian wells owned by Woodbine Land and Improvement Company.

TOWNSHIP OF DENNIS.

Charles E. Foster, Chairman of Township Committee, reports no sewers.

TOWNSHIP OF LOWER.

George Dickinson, Chairman of Township Committee, reports one private sewer, accommodating about forty houses.

TOWNSHIP OF MIDDLE.

No sewers, except terra-cotta storm drain at Cape May Court House.

TOWNSHIP OF UPPER.

Washington Van Gilder, Township Committeeman, reports no sewers.

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CUMBERLAND COUNTY.

CITY OF BRIDGETON.

A. R. Fithian, Mayor, reports:

Separate sewers, 33,537 feet laid, caring for 3,000 population; 490 house connections; estimated discharge, 250,000 gallons; flushing by storm, water and fire hydrants; constructed during the last fifteen years; annual expense for care, $150; system owned by city.

Storm water drainage: 8,350 feet laid.

The sewage is discharged into the Cohansey River.

The water supply is from wells; the total daily consumption is 1,000,000 gallons. The water supply is owned by city.

CITY OF MILLVILLE.

Separate sewerage system, owned by city, discharging, without treatment, into Maurice river, below Union Lake dam. Ground is purchased for future purification.

BOROUGH OF VINELAND.

Ralph H. Garrison, Superintendent of Public Works, reports:

Combined sewers: None.

Separate system: Nine and one-half miles pipe laid, draining nearly one square mile; caring for population of 4,500; 890 house connections; eight factory connections, including shoe, knitting, ice, wrapper, thermometer, macaroni and grape juice factories; one outlet; estimated daily discharge, 280,000 gallons; flushing from flush tanks and hose; system constructed in 1900. Several blocks of extensions are constructed every year; annual expense for care last year was $106.36; kind of care, two men at disposal field and one man occasionally for flushing; system owned by borough.

Discharge: Sewage is discharged into Tarkiln Branch after treatment by intermittent sand filtration. There are eight filter

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beds covering a little over four acres; beds are from two to four feet deep; underdrained by horseshoe tile pipes; beds are cleaned by raking and ploughing; constructed in 1900; sulphate of copper is used in sewage before it passes to the beds.

Water supply: The water supply is from driven wells owned by the Borough. The daily consumption is about 375,000 gallons.

TOWNSHIP OF COMMERCIAL.

No report.

TOWNSHIP OF DEERFIELD.

James McNab, Chairman of Township Committee, reports no sewers.

TOWNSHIP OF DOWNE.

John Gaskill, Chairman of Township Committee, reports no sewers.

TOWNSHIP OF FAIRFIELD.

William H. C. Taylor, Sr., Chairman of Township Committee, reports no sewers.

TOWNSHIP OF GREENWICH.

George L. Watson, Chairman of Township Committee, reports no sewers.

TOWNSHIP OF HOPEWELL.

J. H. Powell, Township Attorney, reports no sewers.

TOWNSHIP OF LANDIS.

No sewers.

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TOWNSHIP OF LAWRENCE.

Peter Johnson, Township Committeeman, reports no sewers.

TOWNSHIP OF MAURICE RIVER.

Charles Grassman, Chairman of Township Committee, reports three storm water drains, about one-half mile in all, of terra cotta pipe, constructed and owned by Maurice River township.

TOWNSHIP OF STOW CREEK.

Charles D. Fogg, Chairman of Township Committee, reports no sewers.

ESSEX COUNTY.

CITY OF EAST ORANGE.

William H. V. Reimer, City Engineer, reports:

Combined sewers: None.

Separate sewers: Number of miles laid, 55⅓; area drained, 4 square miles; population cared for, about 20,000; number of houses drained, 4,935; number of factories drained, 2—electrical equipment and medicine, plasters and bandages; number of outlets, 1; estimated discharge, 2,500,000 gallons; flushing by flush tanks and hose; placed in operation in 1888; about 5,000 linear feet of extensions to 8-inch pipe lines planned; system cared for at annual expense of $1,700; kind of care, inspection; system owned by city.

Storm water drains; Number of miles laid, 3½; area drained, 520 acres; number of outlets, 4; constructed from 1888 to 1904; owned by city.

Disposal: The sewage is discharged into Second river and Passaic river. The storm water is discharged into Elizabeth river.

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Water supply: The water supply is from artesian wells at White Oak Ridge, Millburn, N. J., owned by the city. The daily individual consumption is about 100 gallons.

All sanitary sewers are of vitrified clay pipe, from six inches in diameter to twenty-four inches in diameter. The storm water sewers are of brick and vitrified pipe, from fifteen inches in diameter to five feet six inches in diameter. Sanitary sewer extensions are made as needed, and usually in anticipation of need. No one has to wait for sewer service, as a rule. The storm water service is adequate for the section drained, but other sections to cover nearly three-quarters of the area of the city are needed.

CITY OF NEWARK.

Edward S. Rainkin, Engineer of the Department of Sewers and Drainage, reports:

Combined sewers: Number of miles laid, 162.7; area drained, 85,000 acres; population, 280,000; number of houses, 26,000; number of factories, 2,700 of all kinds; estimated discharge, 46,500,000 gallons per day; flushing from hydrants; annual expense for care, $37,297.94 in 1904; care consists in cleaning and repairing by city; system is owned by city. These statistics include both combined and separate sewers, except as to the number of miles laid. There are sixteen outlets of the combined sewers discharging into the Passaic river and Newark bay without treatment. No important new work is planned, except extensions to present system.

Separate sewers: Number of miles laid, 42.6; number of outlets, 2; flushing, partly by Miller tanks and partly by hand; constructed from 1887 to 1905; no new work planned; system owned by city. Other statistics are included in those given above.

Storm water drains: Number of miles laid, 2.9; area drained, 370 acres; number of outlets, 9; new work planned, none; constructed from 1887 to 1905; owned by the city.

Water-supply: The water-supply is obtained from the Pequan-

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nock river, and is owned by the city. The daily individual consumption is 108 gallons.

Private sewers: private sewers are constructed to discharge into public sewers, and become public sewers after construction under city supervision; 26.3 miles have been laid.

The sewers of about one-third of the city discharge into an intercepting sewer which is designed to carry the house sewage only, the storm water discharging into the meadows. The remainder of the sewage, with the exception of about 900 acres which discharge into the joint outlet sewer, is drained directly into the Passaic river, without treatment.

CITY OF ORANGE.

Separate system, of about 37 miles, discharging through joint outlet sewer in Passaic river, at Second river, without treatment. Part of sewage is pumped. Estimated discharge, 2,000,000 to 3,000,000 gallons daily; about 2,500 house and 15 factory connections; storm water system, discharging into east branch of Rahway river; drainage from hat factories, etc., reaches Rahway river, causing nuisance.

TOWN OF BLOOMFIELD.

George Fisher, Mayor, reports:

Separate sewers: Number of miles laid, 24, including four miles of outlet; area drained, 1,400 acres; population, 8,000; number of houses, 983; number of factories, 7, including woolen mills, electric plant, wall paper factory, etc.; number of outlets, 1; estimated discharge, 3,500,000; flushing by flush tanks. Greater portion of the system was constructed in 1894 and 1895; 2,500 feet of new work planned; annual expense for care of outlet sewer, $350, and of the sewer system, $1.000; the system is owned by the town.

Storm water drains: Number of miles laid, 2; area drained, 200 acres; number of outlets, 14; no new work planned; system constructed before 1890 and 1895; owned by the town.

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Disposal: The sewage is discharged without treatment into the Passaic river by joint outlet sewer.

Water supply: The water supply is from the Passaic river and owned by the East Jersey Water Company. The individual daily consumption is sixty-three gallons.

Private sewers: There are two private sewers discharging into the joint outlet sewer.

TOWN OF IRVINGTON.

Separate system of sewers, connecting with joint outlet sewer to Arthur Kill.

TOWN OF MONTCLAIR.

Malcolm H. Smith, Superintendent of Roads and Sewers, reports:

Comibned sewers: None.

Separate sewers: Number of miles laid, 50; area drained, about 5 square miles; population, 16,370; number of houses drained, 2,300; number of factories drained, 1—printing and glazing paper plant; number of outlets, 1; estimated discharge, 2,000,000 gallons per day; constructed since 1900; short extensions of laterals are planned; annual expense for care is $4,133; care consists of flushing, cleaning and repairing; the system is owned by the town; it discharges into the Passaic river by joint outlet sewer, without treatment.

Water supply: The water supply is obtained from Passaic river; it is owned by the Montclair Water Company.

TOWN OF NUTLEY.

No sewers.

TOWN OF WEST ORANGE.

Alexander Potter, Consulting Engineer, reports:

Combined sewers: None.

Separate sewers: Number of miles laid, 23; area drained, 2,325 acres; population, 8,200; number of houses, 800; number of factories, 2—hat factories; number of outlets, 1; estimated

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discharge, 700,000 gallons per day; flushing by automatic flush-tanks; system constructed from 1903 to 1905; ten miles of new work planned; annual expense for care, $500; care consists of flushing and hand cleaning; system owned by town; discharge through joint outlet sewer into Staten Island Sound, without treatment.

Water supply: The water supply is obtained from the Passaic river and is owned by the Montclair Water Company.

VILLAGE OF SOUTH ORANGE.

Robert S. Sinclair, Village President, reports:

Separate sewers: Number of miles laid, 25; area drained, about 2 square miles; population, 5,000; number of houses, 900; no factories; 12 outlets, each discharging into the joint outlet sewer; estimated discharge, 60,000,000 gallons yearly; flushing by automatic flush tanks; system constructed in 1902 and 1903; no new work planned; annual expense for care, $3,000; system owned by village.

Water supply: The water supply is obtained from wells at Summit and Millburn, owned by the Commonwealth Water and Light Company. The daily individual consumption is forty-seven gallons.

BOROUGH OF CALDWELL.

John J. Van Orden, Borough Clerk, reports no sewers.

Water supply is obtained from driven wells, owned by the borough. Annual consumption is 10,000,000 gallons; population is 1,600.

BOROUGH OF ESSEX FELLS.

No sewers.

BOROUGH OF GLEN RIDGE.

Separate system of about five miles, discharging at six points into Bloomfield sewers and Bloomfield-Montclair joint outlet, thence, without treatment, to Passaic river.

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BOROUGH OF NORTH CALDWELL.

No sewers.

BOROUGH OF WEST CALDWELL.

No sewers or water supply.

TOWNSHIP OF BELLEVILLE.

Thomas H. Brun, Chairman of Township Committee, reports no sewers in township excepting joint outlet sewer passing through township, to Arthur Kill.

Water supply is obtained from city of Newark, the daily consumption being 20,000 gallons.

TOWNSHIP OF CALDWELL.

No sewers, except small private system.

TOWNSHIP OF LIVINGSTON.

B. W. Dickinson, Township Committeeman, reports no sewers.

TOWNSHIP OF MILLBURN.

Alexander Potter, Consulting Engineer, reports:

Separate sewers: number of miles laid, 15; area drained, 2,800 acres; population cared for, 3,500; number of houses, 350; number of factories, 3 paper mills, being large consumers of water; estimated discharge, 6,000,000 gallons per day; flushing by automatic flush-tanks; system canstructed in 1903; new work planned, 4 miles; annual expense for care, $500; system owned by township; discharge through joint outlet sewer into Staten Island Sound.

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Water supply is obtained from wells owned by Commonwealth Water Company.

TOWNSHIP OF SOUTH ORANGE.

No report.

TOWNSHIP OF VERONA.

T. E. Brooks, Township Clerk, reports no sewers excepting two private sewers discharging into Peckman's river, accommodating the Essex County Branch Hospital and the Newark City Home, with one purification plant at Overbrook, consisting of septic tank and primary and secondary sand filters, discharging into Peckman's Brook.

GLOUCESTER COUNTY.

CITY OF WOODBURY.

S. E. Wilmer, Superintendent of water works, reports:

Combined sewers: None.

Separate sewers: Number of miles laid, about 10; area drained, about 4 square miles; population, 4,600; number of houses, 504; number of factories, 1—a piano works; number of outlets, 1; estimated discharge, about 200,000 gallons per day; flushing by flush tanks and fire hydrants; system completed September 24th, 1903; new work planned, about 15,000 feet; annual expense for care last year was $153.48; kind of care, flushing and cleaning basin; system owned by the city; discharge into Woodbury creek, without treatment, by means of storage tank, discharge being on the outgoing tide.

Private sewers: There are three private sewers, accommodating four or five houses, discharging into the Woodbury creek.

Water supply: The water supply is obtained from the Mantua Creek, and is owned by private parties.

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BOROUGH OF CLAYTON.

No sewerage system except three-fourths of a mile of storm water drains constructed in 1895, and owned by the borough.

The water supply is obtained from wells owned by the Borough of Clayton Water Company.

BOROUGH OF NATIONAL PARK.

James E. Lake, Mayor, reports no sewers.

Plans and specifications for a complete water and sewer system have been prepared, but no action has been taken on them as yet. The borough has a small water plant. The plans will be acted upon probably at an early date.

BOROUGH OF PAULSBORO.

No sewers.

BOROUGH OF PITMAN.

No sewers.

BOROUGH OF SWEDESBORO.

W. H. McCullough, Mayor, reports:

Combined sewers: Number of feet laid, 11,420; area drained, 1 square mile; population, 1,600; number of houses, 100; number of outlets, 1; discharge not estimated; flushing from roof drainage and from hydrants when required; system constructed in 1901 and 1902; no new work planned; annual expense for care, $25; for flushing sewer and opening vents; system owned by Swedesboro Sewer Company.

Separate sewers: Number of feet laid, 3,130; area drained about 200 acres; population cared for, 100; number of house connections, 12; number of outlets, 1; discharge not estimated; flushing from roof drainage and hydrants; sewer constructed in 1904; no new work planned; annual expense for care, $10 for flushing and opening traps; system owned by Swedesboro Sewer Company.

Disposal: The sewage is discharged into the Raccoon creek.

Water supply: The water supply is obtained from artesian wells owned by Woolwich Water Company.

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There are ten or twelve private sewers, accommodating fifteen houses, discharging into an open run in the borough, causing pollution of the run and nuisance at times.

BOROUGH OF WENONAH.

Charles H. Lorance, Mayor, reports:

Two private sewers owned by private party (Stephen Green), the water being discharged into cess-pools, and being purified by passing over coke bed. About 40 houses are accommodated.

TOWNSHIP OF DEPTFORD.

Benjamin F. Haines, Chairman of Township Committee, reports no sewers. Water-supply from artesian wells owned by Westville & Newbold Water Company.

TOWNSHIP OF EAST GREENWICH.

No sewers.

TOWNSHIP OF ELK.

Roulef Knisell, Township Committeeman, reports no sewers.

TOWNSHIP OF FRANKLIN.

A. B. Richman, Township Committeeman, reports no sewers.

TOWNSHIP OF GLASSBORO.

No sewers.

TOWNSHIP OF GREENWICH.

No sewers, except 1,200 feet of 12-inch storm-water drain, discharging in Mantua creek.

TOWNSHIP OF HARRISON.

Samuel T. Stratton, Chairman of Township Committee, reports no sewers, excepting one private sewer, accommodating 13 houses, discharging into Raccoon creek. Water-supply.

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TOWNSHIP OF LOGAN.

Isaac Derrickson, Chairman of Township Committee, reports no sewers, excepting one-eighth of a mile storm drain, discharging into Raccoon creek.

TOWNSHIP OF MANTUA.

No sewers.

TOWNSHIP OF MONROE.

No report.

TOWNSHIP OF SOUTH HARRISON.

William Hudson, Chairman of Township Committee, reports no sewers.

TOWNSHIP OF WASHINGTON.

Burris H. Turner, Chairman of Township Committee, reports no sewers.

TOWNSHIP OF WEST DEPTFORD.

No sewers.

TOWNSHIP OF WOOLWICH.

Benjamin Shoemaker, Chairman of Township Committee, reports no sewers.

HUDSON COUNTY.

CITY OF BAYONNE.

F. W. Dalrymple, City Surveyor, reports:

Combined sewers: Number of miles laid, 27,901; area drained, 1,015 acres; population cared for, 37,600; number of houses

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drained, 4,700; number of factories drained, 50, small factories of all kinds; number of outlets, 10; estimated discharge in dry weather, 1,500,000 gallons per day; flushing by hand and storm water; constructed during the past thirty-five years; new work planned, 1 mile; annual expense for care, $1,500, for continuous cleaning and repairs as necessary; system owned by city; discharge without treatment into New York and Newark bays.

No separate sewers; storm water drains are included in same combined system; there are approximately fourteen private sewers discharging into New York and Newark bays without treatment and accommodating approximately 350 houses.

The water supply is obtained from Little Falls and is owned by the New York and New Jersey Water Company; the daily individual consumption is ninety-two gallons.

CITY OF HOBOKEN.

Tivy and Smith, City Surveyors, report:

Combined sewers: Number of miles laid, about 15; area drained, 720 acres; population cared for, about 65,000; number of houses drained, 4,300; number of factories not reported, but there are a large number, consisting of iron works, tanneries, silk factories, notions, etc.; number of outlets, 5; discharge not estimated; no flushing, but occasional cleaning; system owned by city; discharge without treatment into the Hudson river; there are a number of private sewers discharging into the Hudson river of which there is no record.

The sewerage system for the lower meadow section is based on the tidal system. The outlets are provided with sluice gates, which are raised and lowered at the change of the tides by a sluice gate keeper. A few of the sewers coming from the higher section do not require sluice gates; a system of drainage by pumping has been under consideration for some time, but no definite action has been taken toward its adoption.

The water supply is obtained from the Hackensack river at New Milford and is owned by the Hackensack Water Company; the daily individual consumption is about 110 gallons.

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CITY OF JERSEY CITY.

C. A. Van Keuren, Chief Engineer, reports:

Combined sewers: Number of miles laid, 114.02; area drained, 10 square miles; population cared for, 230,000; number of houses drained, 27,000; number of factories drained, 809, of all kinds; number of outlets, 23; estimated discharge, 50 cubic feet per second in dry weather, 5,000 cubic feet per second in stormy weather; flushing by hose attached to fire hydrant; system constructed from time to time as required by growth of city; various extensions are planned; $20,000 per year is appropriated for care; the funds appropriated are not sufficient for proper care; system owned by the city; discharge is into Newark bay, New York bay, Hackensack river and Hudson river without treatment

There are no separate sewers or storm water drains; there are about 100 private sewers, being short branches discharging into public sewers and accommodating between 500 and 800 houses.

The water supply is obtained from the Rockaway river and owned by the Jersey City Company. The daily individual consumption is 100 gallons.

TOWN OF GUTTENBERG.

No report. Combined system of sewers discharging into Hudson river without treatment.

TOWN OF HARRISON.

No report. Combined system of sewers discharging at three points, without treatment, into Passaic river.

TOWN OF KEARNY.

William S. Logan, Town Surveyor, reports:

Combined sewers: Number of miles laid, 21; area drained, 1,200 acres; population cared for, 14,000; number of houses drained, 500; number of factories drained, 4, consisting of linen thread, photograph and pyralin factories; number of outlets, 7; flushing by storm water; system constructed during the past fifteen years; about 1,500 feet of extension is planned; system owned by the town.

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Separate sewers: Half mile laid, draining 50 acres; population cared for, 200; number of houses drained, 40; constructed in 1890; no new work planned; system owned by town.

Sewage is discharged into the Passaic river; the condition of the river is extremely bad.

The water-supply is obtained from the Passaic river, at Little Falls, and is owned by the East Jersey Water Company; daily individual consumption, 50 gallons.

TOWN OF UNION.

No report. Combined system discharging without treatment into Hudson river.

TOWN OF WEST HOBOKEN.

Thomas Nolan, Mayor, reports:

Combined sewers: Number of miles laid, about 16, and 2 miles in course of construction; area drained, 500 acres; population cared for, 28,000; number of houses drained, 3,000; number of factories drained, 26, consisting of silk mills, breweries, street railway shops, etc.; number of outlets, 2; estimated discharge, 1,000,000 gallons per day; flushing by storm water; the northern outlet was constructed in 1889 and the southern outlet in 1895; new work is planned, consisting of relief sewers in the First ward. The annual expense for care is about $2,000; the care consists of cleaning receiving basins and the outlets; the system is owned by the town.

There are no separate sewers; the sewage is discharged into the Hudson and Hackensack rivers.

The water supply is obtained from the Hackensack river, and is owned by the Hackensack Water Company; the daily individual consumption is fifty gallons.

TOWN OF WEST NEW YORK.

No report. Combined sewerage system discharging without treatment in Hudson river.

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BOROUGH OF EAST NEWARK.

Edward Kenny, Mayor, reports:

Combined sewers: Number of miles laid, 1.75; area drained, 60 acres; population cared for, 2,800; number of houses drained, 500; number of factories, 2—shade roller and thread mills; number of outlets 1; system constructed during the past ten years and owned by the borough; no separate sewers or storm water drains; discharge is into the Passaic river without treatment; the condition of the Passaic river is reported as bad; pollution from municipalities from Paterson to Newark.

BOROUGH OF SECAUCUS.

No sewers.

TOWNSHIP OF NORTH BERGEN.

No sewers.

TOWNSHIP OF WEEHAWKEN.

No report. Combined system discharging, without treatment, from five outlets into Hudson river. The outlets include two built jointly by West Hoboken, Union, West New York and Weehawken.

HUNTERDON COUNTY.

CITY OF LAMBERTVILLE.

No sewers, except small storm-water drains.

TOWN OF CLINTON.

Stewart Terriberry, Mayor, reports no public sewers.

BOROUGH OF BLOOMSBURY.

No sewers.

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BOROUGH OF FRENCHTOWN.

J. S. Manners, Mayor, reports:

No public sewers. Six or eight private sewers discharging into cesspools, or into the Delaware river without treatment and accommodating six or eight houses. The water-supply is received from reservoir of Frenchtown Water Company; consumption is limited to 30,000 gallons per year per family.

BOROUGH OF HIGH BRIDGE.

Walter Brinton, Mayor, reports:

No sewers. Water-supply is obtained from spring water running into two reservoirs owned by the borough, each with a capacity of 500,000 gallons; daily individual consumption not estimated.

BOROUGH OF JUNCTION.

Ezra Mason, Mayor, reports:

No combined or separate sewers; about three miles of storm-water drains, draining about thirty acres with one outlet.

Water-supply received from Junction Water Company.

BOROUGH OF STOCKTON.

No sewers, except two short storm-water drains.

TOWNSHIP OF ALEXANDRIA.

No report.

TOWNSHIP OF BETHLEHEM.

William C. Creveling, chairman of Township Committee, reports no sewers.

TOWNSHIP OF CLINTON.

M. J. Wiggins, chairman of Township Committee, reports no sewers.

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TOWNSHIP OF DELAWARE.

C. B. Johnson, chairman of Township Committee, reports no sewers.

TOWNSHIP OF EAST AMWELL.

No sewers.

TOWNSHIP OF FRANKLIN.

A. D. Young, chairman of Township Committee, reports no sewers.

TOWNSHIP OF HOLLAND.

Herbert Buick, chairman of Township Committee, reports no sewers.

TOWNSHIP OF KINGWOOD.

No sewers.

TOWNSHIP OF LEBANON.

J. Watson Baughart, Chairman of Township Committee, reports: No sewers.

TOWNSHIP OF RARITAN.

John H. Shrope, Village Clerk, reports that there is a sewerage system in the village of Flemington. Separate sewers; number of miles laid, 6; area drained, 250 acres; population cared for, 2,200; number of houses drained, 328; number of factories, 2, cut glass and pottery manufacturers; number of outlets, one; flushing by automatic flush tanks; system constructed in 1898; no new work planned; annual expense for care, $800; system owned by Flemington; there are storm water drains; number of miles laid, about 2; area drained, 50 acres; number of outlets, 3;

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no new work planned; constructed within the past twenty years; system owned by the village of Flemington.

Manner of disposal: Discharge of sewage is into Esopus and Mine creeks, after treatment on a disposal field of five acres; sewage is kept in a storage tank with a capacity of 4,000 gallons before discharge on the filter beds; there are four filter beds, each of 1¼ acres, consisting of red shale from two to five feet deep, under-drained with horseshoe tile bound in cheesecloth; the beds are cleaned every three months, or oftener, when necessary; the cost of maintenance of the plant is $150 per annum; ground water is estimated at 5 per cent. to the foot; the system was constructed in 1898 by the village of Flemington; no repairs have been required since the sewers were installed; the system was built under the direction of Waring, Chapman & Farquhar, Engineers; they have worked well, and the village has not had a single complaint of the manner of operation or because of odor.

There are about 20 private sewers, mostly connected with the system.

The water-supply is obtained from the Flemington Water Company.

TOWNSHIP OF READINGTON.

No sewers.

TOWNSHIP OF TEWKSBURY.

Hezekiah Philhower, Secretary of Board of Health, reports no sewers.

TOWNSHIP OF UNION.

Edgar Allen, M.D., Health Officer, reports no sewers.

TOWNSHIP OF WEST AMWELL.

Charles A. Slack, Chairman of Township Committee, reports no sewers.

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MERCER COUNTY.

CITY OF TRENTON.

No report. Combined sewerage system of about 9.75 miles. Seperate system of about 22.7. Discharge is at one point in Delaware river, below city, without treatment. There are about 14,000 sewer connections. About 6.2 miles of storm drains, discharging at six outlets, three in Delaware river and three in Assanpink creek.

BOROUGH OF HIGHTSTOWN.

No sewers. Water supply.

BOROUGH OF HOPEWELL.

No sewers.

BOROUGH OF PENNINGTON.

J. C. Bunn, Borough Clerk, reports:

No sewers. The matter of sewerage will no doubt be taken up in the near future. Water-supply is obtained from a spring located two miles north of the borough, and an artesian well in the borough; it is owned by the Pennington Spring Water Company. There are about two miles of storm-water drains discharging at three points.

BOROUGH OF PRINCETON.

H. L. Robertson, Mayor, reports:

Combined sewers, none.

Separate sewers: Number of miles laid, about 8; area drained, 220 acres; population cared for, estimated at 4,200; number of houses drained, about 550; no factories; number of outlets, 3; estimated discharge, 200,000 per day; flushing by automatic flush tanks and fire hose; most of the system was constructed in 1895 and 1896; the new work planned consists of ordinary extensions; annual expense for care, about $850; system owned by the borough of Princeton.

Manner of disposal: The discharge is made into small tribu-

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taries of Stony Brook and Millstone river, after treatment by broad irrigation on disposal fields; there are three disconnected systems of sewers, the northeasterly, southerly and northwesterly, all of the same kind, having separate sewers and separate irrigation fields and a total area of about 31 acres; distribution on fields is by wooden troughs and earthen gutters; plans for treatment are now under consideration; the material of the present surface is loamy soil; it is under-drained by two, four and six-inch drains; the matter of the southerly field is now being considered; the system is owned by the borough of Princeton, and was constructed in 1895 and 1896; two complaints have been received as to the northeasterly and southerly sewage fields, caused by defective sub-drains; remedies are being provided.

The water-supply is obtained from Stony Brook and an artesion well; it is owned by the Princeton Water Company; the estimated daily individual consumption is 48 gallons.

TOWNSHIP OF EAST WINDSOR.

Aaron Ely, Chairman of Township Committee, reports: No sewers. About three miles of road are laid with storm-water drains.

TOWNSHIP OF EWING.

Alfred M. Lanning reports: No sewers.

TOWNSHIP OF HAMILTON.

No sewers.

TOWNSHIP OF HOPEWELL.

Pierson B. Hunt, Chairman of Township Committee, reports: No public sewers; about 12 private sewers accommodating 12 houses; two discharge into Delaware river and one in Stony Brook; one is located at the County Workhouse, and discharges into a cesspool on farm property and then into a creek emptying into the Delaware river.

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TOWNSHIP OF LAWRENCE.

J. M. Berrien, Township Clerk, reports: No sewers, except small private sewer at Lawrenceville school.

TOWNSHIP OF PRINCETON.

M. Taylor Pyne, Chairman of Township Committee, reports: No sewers.

TOWNSHIP OF WASHINGTON.

No sewers.

TOWNSHIP OF WEST WINDSOR.

Jacob R. Wyckoff, Chairman of Township Committee, reports: No sewers.

MIDDLESEX COUNTY.

CITY OF NEW BRUNSWICK.

The Sewer Committee of the City Council, F. A. Hendricks, George Collins and J. F. Chipen, report:

Combined sewers: number of miles laid, 5½; area drained, 111.6 acres; population cared for, 12,000; number of houses drained, 2,500; number of factories drained, 3—paper, cigars and shoes; number of outlets, 2; constructed 1873; no new work planned; annual expense for care, $1,200.00 for cleaning catch basins.

Separate sewers: number of miles laid, 7; area drained, 364 acres; poulation cared for, 10,000; number of houses drained not reported; number of factories drained, 2—cigar and button; number of outlets, 3; flushing by automatic flush tanks; system owned by city.

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Storm-water drains: number of miles laid, ½ mile; area drained, 60 acres; number of outlets, 1; constructed 1902 by the city.

The sewage is discharged into the Raritan river without treatment There are six private sewers connecting with the main sewer, accommodating about 500 houses.

CITY OF PERTH AMBOY.

No report. Combined system of sewers. About 10 miles laid, discharging, without treatment, at twelve points, into Raritan river and Staten Island sound.

BOROUGH OF DUNELLEN.

No sewers.

BOROUGH OF HELMETTA.

No report. One storm drain and one combined sewer draining four factories, discharging in Manalapan river.

BOROUGH OF HIGHLAND PARK.

No report. Combined system discharging, without treatment, in Raritan river.

BOROUGH OF JAMESBURG.

George A. Shultz, Mayor, reports no sewers.

BOROUGH OF METUCHEN.

No sewers.

BOROUGH OF MILLTOWN.

F. E. Riva, Mayor, reports no sewers.

BOROUGH OF SOUTH AMBOY.

Charles H. Muirheid, Mayor, reports no sewer system, excepting about half a mile of storm-water drain, discharging into Raritan bay, about high-water more on the beach, constructed in 1896 and owned by the borough. The municipality is in great

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need of a proper sewerage system. Occasional efforts have been made to gain consents necessary to proceed in the matter, but so far they have been unsuccessful. It is hoped that enough consents will be obtained to proceed with the matter in the near future.

BOROUGH OF SOUTH RIVER.

No sewers.

TOWNSHIP OF CRANBURY.

No sewers.

TOWNSHIP OF EAST BRUNSWICK.

John O. Cozzens, chairman of Township Committee, reports no sewers.

TOWNSHIP OF MADISON.

Ambrose Green, Chairman of Township Committee, reports no sewers.

TOWNSHIP OF MONROE.

C. H. Edwards, Township Clerk, reports no sewers.

TOWNSHIP OF NORTH BRUNSWICK.

No sewers.

TOWNSHIP OF PISCATAWAY.

No sewers, except half mile of separate sewer at Lincoln, with twenty connections, discharging, without treatment, in Green brook.

TOWNSHIP OF RARITAN.

No public sewers.

TOWNSHIP OF SAYREVILLE.

No sewers.

TOWNSHIP OF SOUTH BRUNSWICK.

John H. Stults, Chairman of Township Committee, reports no sewers.

TOWNSHIP OF WOODBRIDGE.

No report. Combined system discharging in Woodbridge creek without treatment.

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MONMOUTH COUNTY.

CITY OF ASBURY PARK.

John L. Coffin, Superintendent of the Department of Water and Sewers, reports:

Combined sewers: Number of miles laid, 16. Area drained, 500 acres; population cared for: permanent, 5,000; summer, estimated, 30,000; number of houses drained, 1,200; number of factories drained, none; number of outlets, 1; estimated discharge, maximum, 1,000,000 gallons every 24 hours; flushing, occasional, from hydrant; constructed since 1875; no new work planned; annual expense for care, $1,000; supervision and clearing of stoppages; system owned by city.

Separate sewers: None.

Storm water drains: None, except short culverts.

Discharge is made into the Atlantic ocean without treatment.

Under the terms of its contract to purchase, the city receives into its pipes the sewage from a small territory outside of its limits. These sewers are owned by James A. Bradley.

The Asbury Park sewerage system has been built piecemeal by Mr. James A. Bradley, without plans or engineering supervision. It has been extended as occasion required. No pipe in the original system exceeds 12 inches in diameter. There were no manholes, and only 6 or 8 sand traps. There were two 12-inch outlet pipes into the ocean, one extending about 400 feet beyond mean tide, and the other about 150. The sewers emptied into submerged tanks, which were connected with the outlet pipes. A movable screen in it prevented solid matter from flowing into the ocean during the day; at night, the screens were raised and the solids allowed to pass out. The city purchased the sewers from Mr. Bradley in 1903. During this season, an intercepting sewer was laid on Ocean avenue, connecting the two receiving tanks, and all sewage is now carried by gravity to the extreme north boundary of the city, and led 1,200 feet to

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sea from a 12-inch wrought iron discharge pipe. The plan of disposal improvement under which this interceptor and discharge pipe were constructed also provides for a septic tank and necessary pumping plant on the ocean front, but this may not be built for a few years, as the present plan has thus far removed all traces of beach pollution. Careful bacteriological examinations of the water are to be systematically made, and if any of the sewage reaches the shore, it will be detected. The outlet being far beyond the bar, the sewage is quickly and highly diluted and does not come in shore even with strong easterly winds.

CITY OF LONG BRANCH.

No report. Sewerage system discharging into Atlantic ocean after screening solids.

TOWN OF FREEHOLD.

W. S. Matlack, Superintendent, reports:

Combined sewers: None.

Separate sewers: Number of miles laid, 8; area drained, about 640 acres; population cared for, about 3,800; number of houses drained, about 450; number of factories drained, 1, a carpet factory; number of outlets, 1; estimated daily discharge, about 50,000 gallons; flushing by automatic flush-tanks; system constructed in 1892; no new work planned; annual expense for care, about $1,000; system owned by town.

Disposal: Effluent is discharged into a tributary of the Shark river after treatment in disposal fields. The sewage is collected in a storage tank and discharged on four beds, two two acres in area and the other two six acres in area. Each bed is about four feet deep. The distribution over the beds is by channel pipe with outlets. The beds are underdrained every twenty-five feet with three-inch outlet drains. Very little ground water enters the system. It was constructed in 1892 and is owned by the town. Two of the disposal fields are used each year for filtering water, and these are ploughed and harrowed and kept free of weeds and grass. Two are farmed for raising corn. The two in use for filtering purposes in one year are used for corn the following year. The sewer farm is in fine condition and gives no trouble

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The tank has a capacity of 22,000 gallons and is provided with movable screens to arrest all coarse material, which is thus kept from going on the filter beds.

Water supply: The water supply is obtained from artesian wells owned by the town. The daily individual consumption is about 160 gallons.

TOWN OF KEYPORT.

M. B. Taylor reports no sewerage system.

TOWN OF RED BANK.

J. W. J. Bonnell, Chief Commissioner, reports:

Combined sewers: None.

Separate sewers: There is a separate system, the number of miles laid not being reported. It has one outlet and an estimated discharge of 250,000 gallons in twenty-four hours. The annual expense for care is $500. The system is owned by the town.

Storm water drains: There are a few short storm water drains, details not reported.

Disposal: The sewage is discharged into the North Shrewsbury river after treatment by septic tank and filters. The capacity of the tank is 100,000 gallons. It takes from seven to twelve hours' flow. The tank has not been cleaned since 1902, when it was erected. Some ground water enters the system, the amount not reported. The system is owned by the town.

Private sewers: There are some private sewers, almost all of which have been connected with the town sewers.

Water supply: The water supply is obtained from artesian wells owned by the town.

BOROUGH OF ALLENHURST.

No report. Separate sewerage system. About three miles laid. Discharges into Atlantic ocean without treatment.

BOROUGH OF ALLENTOWN.

No sewers.

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BOROUGH OF ATLANTIC HIGHLANDS.

No report. Sewerage system discharging without treatment in Sandy Hook bay. Purification plant being considered.

BOROUGH OF AVON-BY-THE-SEA.

No report. Sewerage system discharging into Atlantic ocean without treatment.

BOROUGH OF BELMAR.

No report. Separate sewerage system of about nine miles, discharging at two points in Atlantic ocean, without treatment, by submerged outlets 300 and 800 feet from shore.

BOROUGH OF BRADLEY BEACH.

No report. Sewerage system discharging into Atlantic ocean without treatment.

BOROUGH OF DEAL.

No report. Sewerage system discharging into Atlantic ocean without treatment.

BOROUGH OF ENGLISHTOWN.

No sewers.

BOROUGH OF FARMINGDALE.

No sewers.

BOROUGH OF HIGHLANDS.

No sewers.

BOROUGH OF MANASQUAN.

V. T. Miller, Chairman of Sewer Committee, reports:

Separate system: Number of miles laid, about 5½; population cared for, 1,600; number of houses drained, nearly 100; number

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of factories drained, 1, a cold storage plant; number of outlets, 1; kind of flushing, from hydrants; system constructed December, 1904; no expense for maintenance; system owned by borough.

Disposal: The sewage is discharged into the Atlantic Ocean after treatment by septic tank.

Water supply: The water supply is obtained from artesian wells owned by the borough.

BOROUGH OF MATAWAN.

No sewers.

BOROUGH OF NEPTUNE CITY.

No sewers.

BOROUGH OF SEABRIGHT.

No report. Separate system, about three miles laid, discharging, without treatment, in Shrewsbury river.

BOROUGH OF SPRING LAKE.

No report. Separate system, about four miles laid, discharging in Atlantic ocean, without treatment, at three points, 680 feet from shore.

TOWNSHIP OF ATLANTIC.

H. W. Buck, Chairman of Township Committee reports no sewers.

TOWNSHIP OF EATONTOWN.

Benjamin Eldridge, Chairman of Township Committee, reports no sewers.

TOWNSHIP OF FREEHOLD.

No sewers.

TOWNSHIP OF HOLMDEL.

Wesley Mason, Chairman of Township Committee, reports no sewers.

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TOWNSHIP OF HOWELL.

B. M. Cooper, Chairman of Township Committee, reports no sewers.

TOWNSHIP OF MANALAPAN.

Edward Hendrickson, Chairman of Township Committees, reports no sewers.

TOWNSHIP OF MARLBORO.

No sewers.

TOWNSHIP OF MATAWAN.

L. H. Stemler, Chairman of Township Committee, reports no sewers. Water supply is obtained from Matawan Water Works, owned by the borough of Matawan.

TOWNSHIP OF MIDDLETOWN.

Henry D. Smith, Township Clerk, reports no sewers. There are a few private sewers discharging into the North Shrewsbury river after treatment.

TOWNSHIP OF MILLSTONE.

John H. Ely, Chairman of Township Committee, reports no sewers.

TOWNSHIP OF NEPTUNE.

There are no public sewers in the township of Neptune. There is a private sewerage sysem owned by James A. Bradley. The sewage reaches the Atlantic ocean without treatment.

TOWNSHIP OF OCEAN.

No sewers.

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TOWNSHIP OF RARITAN.

No sewers.

TOWNSHIP OF SHREWSBURY.

No report. No public sewers. A few private sewers, discharging in Shrewsbury river.

TOWNSHIP OF UPPER FREEHOLD.

Thomas Meirs, Township Clerk, reports no sewers.

TOWNSHIP OF WALL.

Charles Gifford, Chairman of Township Committee, reports no sewers.

MORRIS COUNTY.

TOWN OF BOONTON.

E. P. Looker, Mayor, reports no sewers.

TOWN OF DOVER.

I. W. Searing, Mayor, reports no sewers. A sewer system is contemplated, but no plans have been prepared.

TOWN OF MORRISTOWN.

Charlton A. Reed, Mayor, reports no sewerage system, excepting about two miles of storm water drains and detached sections. It is planned to relay about 1,200 feet which is not of sufficient capacity to carry off the rainfall. These have been laid from time to time as they were needed, and they are owned by the

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town. There is a small amount of pollution, due to private drains running into water courses. Water supply is obtained from reservoir belonging to the proprietors of the Morris aqueduct.

BOROUGH OF BUTLER.

H. V. Day, Mayor, reports no sewers. Water supply is obtained from Butler Water Company.

BOROUGH OF CHATHAM.

Frank N. Kelley, Mayor, reports no sewers. Water supply is obtained from artesian wells owned by the borough.

BOROUGH OF FLORHAM PARK.

Howard E. Young, Borough Clerk, reports no public sewers. Two private sewers discharging into Black brook and thence into the Passaic river, causing some pollution.

BOROUGH OF MADISON.

No report. No sewers. Plans for combined system and purification plant are being considered.

BOROUGH OF MOUNT ARLINGTON.

R. J. Chaplin, Mayor, reports no sewers, excepting one private sewer for the Breslin Hotel.

BOROUGH OF NETCONG.

No sewers.

BOROUGH OF ROCKAWAY.

George W. Stickel, Mayor, reports no sewerage system; water-supply owned by borough.

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BOROUGH OF WHARTON.

J. H. Williams, Mayor, reports no sewers.

TOWNSHIP OF BOONTON.

W. R. Bailey, Chairman of Township Committee, reports no sewers.

TOWNSHIP OF CHATHAM.

Nathaniel Clark, Township Clerk, reports no sewers.

TOWNSHIP OF CHESTER.

S. H. De Camp, Chairman of Township Committee, reports no sewers.

TOWNSHIP OF HANOVER.

No sewers.

TOWNSHIP OF JEFFERSON.

No sewers.

TOWNSHIP OF MENDHAM.

George W. Savadge, Chairman of Township Committee, reports no sewers.

TOWNSHIP OF MONTVILLE.

John Husk, Jr., Chairman of Township Committee, reports no sewers and no water-supply.

TOWNSHIP OF MORRIS.

Phœnix Miller, Chairman of Township Committee, reports no sewers.

TOWNSHIP OF MOUNT OLIVE.

W. R. McPeak, Chairman of Township Committee, reports no sewers.

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TOWNSHIP OF PASSAIC.

Thomas Melee, Chairman of Township Committee, reports no sewers.

TOWNSHIP OF PEQUANNOCK.

No sewers.

TOWNSHIP OF RANDOLPH.

J. L. Connolly, Chairman of Township Committee, reports no sewers.

TOWNSHIP OF ROCKAWAY.

No sewers.

TOWNSHIP OF ROXBURY.

David B. Jardine, Chairman of Township Committee, reports no sewers.

TOWNSHIP OF WASHINGTON.

No sewers.

OCEAN COUNTY.

BOROUGH OF BARNEGAT CITY.

No sewers.

BOROUGH OF BAY HEAD.

Aaron S. Pennington, Mayor, reports no sewers. Sewers will probably soon be necessary in the borough.

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BOROUGH OF BEACH HAVEN.

Separate sewerage system, about two miles and a half laid, discharging at two points in Little Egg Harbor bay without treatment.

BOROUGH OF HARVEY CEDARS.

F. A. Lee, Mayor, reports no sewers.

BOROUGH OF ISLAND HEIGHTS.

No report. Small sewerage system constructed by the borough.

BOROUGH OF LAVELETTE.

No sewers.

BOROUGH OF POINT PLEASANT BEACH.

No sewers.

BOROUGH OF SEASIDE PARK.

J. B. Wood, Borough Clerk, reports:

Combined sewers: Number of miles laid, about 1½; area drained, 50 acres; population cared for, 800 in summer, 100 in winter; number of houses drained, about 50 houses and 2 hotels; no factories; two outlets; estimated discharge is 50,000 gallons for 24 hours; flushing with fire hose; system constructed from 1899 to 1902; annual expense for care, nominal; no new work planned; kind of care, indifferent; system owned by Seaside Park Light, Water and Sewer Company; the sewage is discharged into Barnegat Bay without treatment.

No separate sewers.

No storm water drains.

The sewer system is in poor condition; it is often stopped up or broken. It empties in the bay about 200 feet from the shore and is at times very offensive. A disposal plant should be provided. At this times, both outlets are broken and discharge at the water's edge.

BOROUGH OF SURF CITY.

H. L. Lukens, Borough Clerk, reports no sewers.

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BOROUGH OF TUCKERTON.

F. R. Austin, Mayor, reports no sewers.

TOWNSHIP OF BERKELEY.

S. R. Johnson, Chairman of Township Committee, reports no sewers.

TOWNSHIP OF BRICK.

No sewers.

TOWNSHIP OF DOVER.

W. Scott Jackson, Chairman of Township Committee, reports no sewers.

TOWNSHIP OF EAGLESWOOD.

H. T. Willets, Township Clerk, reports no sewers.

TOWNSHIP OF JACKSON.

No sewers.

TOWNSHIP OF LACEY.

B. F. Holmes, reports no sewers.

TOWNSHIP OF LAKEWOOD.

No report.

TOWNSHIP OF LITTLE EGG HARBOR.

Ayer Parker reports no sewers.

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TOWNSHIP OF LONG BEACH.

No sewers.

TOWNSHIP OF MANCHESTER.

No sewers.

TOWNSHIP OF OCEAN.

J. R. Stokes, Chairman of Township Committee, reports no sewers.

TOWNSHIP OF PLUMSTED.

W. F. Robbins, Chairman of Township Committee, reports no sewers, excepting three or four private sewers of tile and terra cotta pipe. One at the Hotel American, discharging into Crosswick's creek, causes some nuisance.

Water supply is obtained from artesian wells for the village of New Egypt, and is owned by the New Egypt Water Company.

TOWNSHIP OF STAFFORD.

E. E. Predmore, Chairman of Township Committee, reports no sewers.

TOWNSHIP OF UNION.

J. Horace Sprague, Chairman of Township Committee, reports no sewers.

PASSAIC COUNTY.

CITY OF PASSAIC.

Thomas R. Watson, City Clerk, reports:

Combined sewers: Number of miles laid, two-tenths; area drained, 30.5 acres; population cared for, 1,080; number of

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houses drained, 180; no factories; one outlet; estimated discharge, 60,000 gallons for twenty-four hours; automatic flushing; constructed in 1890; no new work planned; annual expense for care, about $50 for inspection and cleaning; system owned by city.

Separate sewers: Number of miles laid, 36.3 and in addition 24.26 miles of house connections; area drained 1.8 square miles; population cared for, 32,000; number of houses drained, 3,500; number of factories drained, 40, consisting of woolen, worsted, prints, cotton, rubber, foundries, etc.; number of outlets, 10; estimated discharge, 3,500,000 gallons per twenty-four hours; automatic flushing; constructed from 1890 to 1905; new work planned of about 450 feet of eight-inch sewer; annual expense for care, $2,500 for inspection and cleaning; system owned by city.

Storm water drains: Number of miles laid, 2.22; area drained about 600 acres; number of outlets, 2; no new work planned; constructed yearly, largest portion from 1892 to 1902; system owned by city.

The sewage is discharged into the Passaic River without treatment.

Water supply: The water supply is obtained from the upper Passaic river, and is owned by Acquackanonk Water Company, East Jersey Water Company, lessee. The total daily consumption is 3,000,000 gallons.

CITY OF PATERSON.

Combined sewerage system; about 72 miles laid, discharging at 22 points into Passaic River without treatment; about 8,000 house and 500 factory connections; estimated daily discharge 17,000,000 gallons per day from sewerage system and 7,000,000 gallons per day directly from factories in addition. No separate sewers.

BOROUGH OF HAWTHORNE.

No sewers.

BOROUGH OF NORTH HALEDON.

William H. Robinson, Mayor, reports no sewers.

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BOROUGH OF POMPTON LAKES.

No sewers.

BOROUGH OF PROSPECT PARK.

Adrian Struyk, Mayor, reports no sewers.

BOROUGH OF TOTOWA.

Henry R. Crews, Mayor, reports no sewers.

TOWNSHIP OF ACQUACKANONK.

No sewers.

TOWNSHIP OF LITTLE FALLS.

James C. Stanley, Chairman of Township Committee, reports no sewers, excepting one-half mile of storm water drains. Water supply is received from Little Falls Water Company.

TOWNSHIP OF MANCHESTER.

Samuel Rogers, Chairman of Township Committee, reports no sewers.

TOWNSHIP OF POMPTON.

No sewers.

TOWNSHIP OF WAYNE.

H. M. Berdan, Township Clerk, reports no sewers.

TOWNSHIP OF WEST MILFORD.

No sewers.

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SALEM COUNTY.

CITY OF SALEM.

No report. Sewerage system owned by city, discharging without purification in Delaware River.

BOROUGH OF ELMER.

David P. Cochran, Mayor, reports no sewers.

BOROUGH OF PENNSGROVE.

George H. Elkinton, Mayor, reports no sewers.

BOROUGH OF WOODSTOWN.

No public sewers. Three or four private sewers discharging into Salem Creek and causing a nuisance. The Woodstown Sewer Company was recently incorporated and plans for a sewerage system and disposal works are being prepared.

TOWNSHIP OF ALLOWAY.

No public sewers. One small private sewer.

TOWNSHIP OF ELSINBORO.

James B. Nicholson, Chairman of Township Committee, reports no sewers.

TOWNSHIP OF LOWER ALLOWAYS CREEK.

No sewers.

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TOWNSHIP OF LOWER PENNS NECK.

No sewers.

TOWNSHIP OF MANNINGTON.

No sewers.

TOWNSHIP OF OLDMANS.

No sewers.

TOWNSHIP OF PILESGROVE.

Samuel A. Ridgway, Chairman of Township Committee, reports no sewers.

TOWNSHIP OF PITTSGROVE.

No sewers.

TOWNSHIP OF QUINTON.

Andrew S. Harris, Township Treasurer, reports no sewers excepting one private sewer accommodating eleven houses.

TOWNSHIP OF UPPER PENNS NECK.

Joseph E. Clark, Township Committeeman, reports no sewers excepting about 700 feet of terra cotta pipe laid to drain a stagnant pond.

TOWNSHIP OF UPPER PITTSGROVE.

T. Paulding, Clerk of township, reports no sewers.

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SOMERSET COUNTY.

TOWN OF RARITAN.

No report. Sewerage system discharging at two points without treatment into Raritan river.

TOWN OF SOMERVILLE.

No report. Sewerage system, about six miles laid, discharging at two points without treatment, into Raritan river.

BOROUGH OF BOUND BROOK.

Richard H. Brokaw, Mayor, reports:

Combined sewers: Number of miles laid, 7; area drained, 2 square miles; population cared for, 3,500; number of houses drained, 112; number of factories drained, 3, woolen and brass; number of outlets, 1; flushing by water from fire hydrants; constructed in 1897 and 1900; new work planned, about 600 feet; annual expense for care, $500, for flushing, cleaning, etc.; system owned by borough; discharge is into the Raritan river without treatment.

Water supply: The water supply is obtained from mountain streams and driven wells. It is owned by the Bound Brook Water Company.

A new extension with separate outlet is being considered.

BOROUGH OF MILLSTONE.

P. V. D. Van Doren, Mayor, reports no sewers.

BOROUGH OF NORTH PLAINFIELD.

No sewers. A system is being considered.

BOROUGH OF ROCKY HILL.

No sewers, except a few small drains.

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TOWNSHIP OF BEDMINSTER.

No sewers.

TOWNSHIP OF BERNARDS.

Vancleve Meeker, Chairman of Township Committee, reports no sewers, except 500 feet of sewers discharging into Mine creek at Bernardsville.

TOWNSHIP OF BRANCHBURG.

J. C. Stryker, Chairman of Township Committee, reports no sewers.

TOWNSHIP OF BRIDGEWATER.

Bernhard Meyer, Chairman of Township Committee, reports no sewers.

TOWNSHIP OF FRANKLIN.

Elias Baker, member of Township Committee, reports no sewers.

TOWNSHIP OF HILLSBOROUGH.

J. Vred Opie, Chairman of Township Committee, reports no sewers.

TOWNSHIP OF MONTGOMERY.

George W. Campbell, Chairman of Township Committee, reports no sewers.

TOWNSHIP OF NORTH PLAINFIELD.

No sewers.

TOWNSHIP OF WARREN.

No sewers.

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SUSSEX COUNTY.

TOWN OF NEWTON.

A combined sewerage system is being constructed; there will be two outlets, each with purification plant, consisting of septic tank, sand filters and sludge bed.

BOROUGH OF ANDOVER.

No sewers.

BOROUGH OF BRANCHVILLE.

No report.

BOROUGH OF HOPATCONG.

R. L. Edwards, Mayor, reports no sewers.

BOROUGH OF STANHOPE.

No sewers.

BOROUGH OF SUSSEX.

No report.

TOWNSHIP OF ANDOVER.

Charles C. Cox, Chairman of Township Committee, reports no sewers.

TOWNSHIP OF BYRAM.

No sewers.

TOWNSHIP OF FRANKFORD.

No sewers.

TOWNSHIP OF FREDON.

No sewers.

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TOWNSHIP OF GREEN.

No sewers.

TOWNSHIP OF HAMPTON.

A. J. Williams, Chairman of Township Committee, reports no sewers.

TOWNSHIP OF HARDYSTON.

Robert L. Edsall, Chairman of Township Committee, reports no sewers.

TOWNSHIP OF LAFAYETTE

No sewers.

TOWNSHIP OF MONTAGUE.

Timothy Shay, Chairman of Township Committee, reports no sewers, excepting a four-inch tile drain, fifty feet long, at the creamery of the Rock Spring Company.

TOWNSHIP OF SANDYSTON.

A. B. Van Sickle, Chairman of Township Committee, reports no sewers.

TOWNSHIP OF SPARTA.

W. H. Beatty, Chairman of Township Committee, reports no sewers. Water supply from Morris lake and spring.

TOWNSHIP OF STILLWATER.

William E. Titman, Chairman of Township Committee, reports no sewers.

TOWNSHIP OF VERNON.

No sewers.

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TOWNSHIP OF WALPACK.

No sewers.

TOWNSHIP OF WANTAGE.

J. Irving Brink, Chairman of Township Committee, reports no sewers.

UNION COUNTY.

CITY OF ELIZABETH.

No report. Combined sewerage system; about 42 miles laid; discharging without treatment at 13 points into Elizabeth river and Staten Island sound. Joint outlet sewer from western Essex county discharges into sound at Elizabeth.

CITY OF PLAINFIELD.

Andrew J. Gavett, City Surveyor, reports:

Combined sewers: None.

Separate sewers: Number of miles laid, 33.37; population cared for, about 12,000; number of house and factory connections, 2,319; no factory wastes in sewers; number of outlets, 1; estimated discharge, 1,000,000 gallons per day; flushing by flush-tanks and flushing valves; constructed from 1894 to 1904; new work planned for 1.8 miles; annual expense for care, $2,000, including part of engineer's salary and regular inspection of sewers and flushing appliances; system owned by city.

Storm water drains: Number of miles laid, 4.23; number of outlets, 17; 568 feet of new work planned; construction from 1872 to date; system owned by city.

Disposal: The sewage is discharged into Green Brook after treatment by septic tanks and double contact beds. Total capacity of septic tanks, 450,000 gallons. Time of flow in tank, about eleven hours. Velocity in tank about nine feet per hour. Tank cleaned twice a year. Four upper and four lower contact beds, each 92 by 106 feet; beds are of stone, slag and clinker, and have a working depth of four feet; distribution is by open jointed pipes, but this system will be changed; under-

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drains are of horseshoe tiles. Annual cost of maintenance is $2,000, including part of engineer's salary. The plant was constructed in 1901, and is owned by the city. There is considerable ground water at times. The plant is now being more than doubled, construction work now going on. In the removal of sludge, lime or permanganate of potash is used.

There are a few private sewers connecting with city system. Water supply from driven wells owned by Plainfield Water Company.

CITY OF RAHWAY.

No report. Sewerage system discharging into Rahway river without treatment.

CITY OF SUMMIT.

No report. Separate sewerage system, connecting with joint outlet sewer to Arthur kill.

TOWN OF WESTFIELD.

No report. Separate sewerage system; about 12 miles laid; discharging at one point in Robinson's branch of Rahway river after treatment; purification plant consists of distributing chamber and sand filters.

BOROUGH OF FANWOOD.

No sewers.

BOROUGH OF GARWOOD.

Volney Winslow, Mayor, reports no public sewers. Private sewers discharging in meadows. Borough engineer is now preparing plans for sewers. There are about 1500 feet of sewers laid, draining about 34 houses.

BOROUGH OF LINDEN.

No sewers.

BOROUGH OF MOUNTAINSIDE.

A. M. Parkhurst, Mayor, reports no sewers.

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BOROUGH OF NEW PROVIDENCE.

Thomas P. Crane, Mayor, reports no sewers.

BOROUGH OF ROSELLE.

W. E. Miner, Mayor, reports no combined sewers. Separate sewers: number of mil laid, 6.5 of laterals and 2.42 miles of main; area drained, about 365 acres; population cared for, 1300; number of houses drained, 260; number of outlets, 1; flushing by automatic flush tanks; constructed in 1895; no new work planned; annual expense for care, $438 in 1904; system owned by borough. Discharge into Morse's creek, without treatment.

Water-supply from wells at Plainfield owned by Union Water Company.

BOROUGH OF ROSELLE PARK.

P. B. Polhemus, Chairman of Sewer Committee, reports no combined sewers. Separate sewers: number of miles laid, 9.3; area drained, 233 acres; population cared for, 1500; number of houses drained, 251; no factories; one outlet; estimated discharge, 250,000 gallons per day; flushing by siphon flush tanks; constructed from 1903 to 1905; no new work planned; annual expense for care, $500 for inspection of house connections, cleaning, inspection and flushing; system owned by borough; discharge into Staten Island Sound, without treatment, through joint outlet sewer. The system is built of vitrified clay pipe from 8 inches to 15 inches in diameter, with manholes at street intersections and bends in the line averaging 300 feet apart. Flush tanks at ends of laterals. It is designed to drain all of the borough except about 85 acres of lowland.

Water-supply is from artesian wells at Netherwood owned by Union Water Company. The daily individual consumption is estimated at 60 gallons.

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TOWNSHIP OF CLARK.

No sewers.

TOWNSHIP OF CRANFORD.

No report. Separate sewerage system; about 10 miles laid; discharging without treatment at one point in Rahway river, below city of Rahway, through trunk.

TOWNSHIP OF FANWOOD.

Edward D. Hand, Township Clerk, reports no sewers.

TOWNSHIP OF LINDEN.

Walter E. Mitchell, Chairman of Township Committee, reports no sewers. About twelve houses have private drains, discharging into West Brook.

TOWNSHIP OF NEW PROVIDENCE.

Henry S. Fullerton, Chairman of Township Committee, reports no sewers.

TOWNSHIP OF SPRINGFIELD.

John L. Denman, Chairman of Township Committee, reports no sewers excepting the joint outlet sewer passing through the township. Under agreement with the township property along the sewer has right to connect.

TOWNSHIP OF UNION.

No report. No sewers except private sewer at Elmore connecting with sewers of city of Elizabeth.

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WARREN COUNTY.

TOWN OF BELVIDERE.

Nicholas Harris, Mayor, reports no public sewers. The Belvidere Sewer Company, organized by citizens, constructed a sewer some years ago in Second street. The Court House and a number of private houses are connected with it. It discharges into the Delaware river. In 1904 a sewer was constructed from the public school building down Fourth street to the Delaware river. In addition to this there are a number of small private sewers discharging into the Delaware river and Pequest creek. Sewers are needed.

TOWN OF HACKETTSTOWN.

Frank M. Cook, Mayor, reports no sewers. Water supply owned by the town, obtained from reservoirs on the hills near the town.

TOWN OF PHILLIPSBURG.

Robert Parsons Howell, Town Surveyor, reports:

Combined sewers: Number of miles laid, 7; area drained, 900 acres; population, 13,000; number of houses drained, 400; number of factories drained, 4, two silk mills, 1 warren foundry and 1 drill works; number of outlets, 4; flushing by storm water and fire hose; constructed in 1890; 1 mile of new work under construction; system owned by town; discharge into Delaware river without treatment. The outlets are near the mouth of the Lehigh river, which is polluted much worse than the pollution from town.

Water-supply is obtained from Delaware river, one mile above town and is owned by Peoples Water Company.

BOROUGH OF WASHINGTON.

No report. About 1.5 miles of separate sewers, with about 50 connections, discharging at one point, without treatment into Shattecong creek.

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TOWNSHIP OF ALLAMUCHY.

C. W. Puffer, Committeeman, reports no sewers, excepting two private sewers.

TOWNSHIP OF BLAIRSTOWN.

Charles Heldemore, Chairman of Township Committee, reports no sewers, excepting seven private sewers accommodating seven houses. Water supply is obtained from driven well owned by Blair Academy.

TOWNSHIP OF FRANKLIN.

No sewers.

TOWNSHIP OF FRELINGHUYSEN.

No sewers.

TOWNSHIP OF GREENWICH.

George E. Hamlin, chairman of Township Committee, reports no sewers.

TOWNSHIP OF HARDWICK.

H. O. Carhart, M.D., Health Inspector, reports no sewers.

TOWNSHIP OF HARMONY.

No sewers.

TOWNSHIP OF HOPE.

No sewers.

TOWNSHIP OF INDEPENDENCE.

Aaron B. Leigh, chairman of Township Committee, reports no sewers.

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TOWNSHIP OF KNOWLTON.

No report. Storm drain, about 500 feet long, discharging into Delaware river.

TOWNSHIP OF LOPATCONG.

Elmer F. Schiffert, Township Clerk, reports no sewers.

TOWNSHIP OF MANSFIELD.

I. V. Leigh reports no sewers.

TOWNSHIP OF OXFORD.

E. W. Sharps, Township Committeeman, reports no sewers.

TOWNSHIP OF PAHAQUARRY.

No sewers.

TOWNSHIP OF POHATCONG.

No sewers.

TOWNSHIP OF WASHINGTON.

No sewers.

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